INSTITUTE OF CHILD WELFARE, MONOGRAPH NO. 21

Intellectual Status at Maturity as a Criterion for Selecting Items in Preschool Tests

KATHARINE M. MAURER

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INTELLECTUAL STATUS AT MATURITY AS A CRITERION FOR SELECTING ITEMS IN PRESCHOOL TESTS

Katharine M. Maurer

CHILD WELFARE MONOGRAPH NO. 21

There is a widespread and practical need for intelligence tests that are suitable for use with very young children. To further the development of such predictive measures, Katharine M. Maurer in this study examines adult status as a criterion of item selection for preschool tests.

Files in the Institute of Child Welfare at the University of Minnesota contain data on children tested with the Minnesota Preschool Scales beginning in 1926. Mrs. Maurer sought out a large group of these same subjects, now young adults, secured their cooperation, and retested them with an adult measure of intelligence. This report contains her evaluation of the test items in the preschool scales in terms of this group's performance as adults.

Mrs. Maurer says: "With the possible exception of records referred to by Wellman on children

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INTELLECTUAL STATUS AT MATURITY AS A CRITERION FOR SELECTING ITEMS IN PRESCHOOL TESTS

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INTELLECTUAL STATUS AT MATURITY AS A CRITERION FOR SELECTING ITEMS IN PRESCHOOL TESTS

BY

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FOREWORD

As successive mental tests on the same children over long periods of time are accumulated, scientific and practical problems, previously inaccessible to study, become open to research. In many of our present intelligence tests, items and questions are included because of a demonstrated relation to the criteria of intelligence over a short span of years. However well such tests may classify children at the time, it does not necessarily follow that they will predict over a long period or that they are the best tests for predicting potentiality, as distinguished from those determining present status. Often a predictive value that cannot be justified is imputed to tests of present status. For purposes of predicting potentiality, test items given a child at any level should be evaluated in terms of later performance as an adult. Such an analysis should result in much better tests for the earlier age levels, especially if items of little or no predictive value can be replaced by items of greater predictive value. This is essentially the problem to which Dr. Maurer has addressed herself in this monograph.

Two hundred and twenty-six young men and women between 16½ and 22 years, who had been tested on the Minnesota Preschool Scales before the age of six, were given the Wells Revision of the Army Alpha Test. A supplementary group of 50 cases given Stanford-Binet tests between 11½ and 15½ years were also used. A detailed analysis of the 448 items included in the two forms of the preschool test was made to determine the value of each item in predicting intelligence level in adolescence or early maturity.

The results of the study indicate that only about half the items have long-time predictive value; the remainder seem to be of little use for this purpose. Below three years the predictive items are largely nonverbal; after three years they are verbal. In general, the younger the age at which tests are given, the less is the predictive value of any item. For the benefit of persons concerned with the construction of tests, the results for the items are presented in great detail. In addition, there is a comprehensive discussion, growing out of the data presented, of the conditions and principles that govern the development of good tests of general intelligence for young children.

This study will be of great value to those engaged in constructing or devising tests, for it makes possible the design of more powerful and efficient instruments for predicting the course of future development. These in turn, because of their greater value for classification purposes, should benefit children and aid parents, teachers, and social workers in meeting practical problems. The principles derived are also of interest to those concerned in any way with the understanding and use of mental tests for scientific and practical purposes.

John E. Anderson
Director, Institute of Child Welfare
University of Minnesota

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I. INTRODUCTION

A Basic Assumption of Intelligence Testing

The first successful intelligence test was developed to meet a practical emergency. Compulsory education, established in France near the beginning of the present century, brought to the public schools large numbers of children who were unable to profit by the usual classroom procedures. A commission was created to devise a plan for segregation of the dull, that they might not impede the progress of the more intelligent children and that special educational methods might be applied to the slow learners. Binet, a psychologist and physician who had been interested in mental measurement for many years, was a member of the commission. He developed a series of tests, known to us as the 1905 Binet-Simon Scale (17), presumed to discriminate between intelligent and unintelligent children. The value of the scale was soon demonstrated by comparing teachers' ratings, school achievement, and subsequent school behavior with the test results.

Binet improved his scale by several revisions (15, 16). Since his death in 1911 it has been further revised, extended, translated, and refined by test makers in many other countries besides France. The most widely used revisions in America are those of Terman (84) in 1916 and Terman and Merrill (86) in 1937. By the use of these and other revisions of the Binet tests large numbers of American school children have been tested and retested after varying intervals of time. Although there have always been exceptions, comparisons of test and retest standings of large groups of children bear evidence of the stability in level of mental functioning. Additional evidence of this stability is furnished by reports on the subsequent careers of gifted children (48, 85, 87) and of dull children (10) and by retests of feebleminded individuals (60). Since the permanent nature of feeblemindedness has been recognized, intelligence tests have been employed as aids to diagnosis of this condition. Their use for this purpose arises from the belief that they predict final intellectual status.

The Present Status with Respect to Predictive Value

A high degree of consistency between test and retest on the same children has been repeatedly demonstrated when the first test is given after 6 years of age. These correlations commonly run as high as +.80 to +.90. More specifically, a large number of investigations have shown that approximately 50 per cent of children, first tested after the age of 6 and retested several years later, will vary not more than 5 points in either direction, provided the same scale is used and testing conditions are suitable on both occasions (40). However, this leaves 50 per cent to be accounted for, and this group has been shown to change considerably more than 5 points on retests. For example, in a study of retests on 441 children Hildreth (47) reports that 4.3 per cent of those first tested after 6 years of age changed 20 points or more upon retests, while 19 per cent of those under 6 at the time of the first test showed changes of this magnitude. It is this more changeable 50 per cent that are frequently overlooked by fervent hereditarians and as frequently overemphasized by certain environmentalists. As has been pointed out in discussions of test-retest changes, there are many reasons other than actual change in level of mental functioning which may account for irregularities of test performance from one occasion to another. Variations may be due to such factors as use of poorly standardized tests, poor testing conditions, inadequately trained examiners, emotionally disturbed children as subjects, errors in scoring, and the accumulation of borderline successes or failures--to mention only a few.* Even so, it is generally agreed that there is enough consistency from test to retest administered to children of school age to warrant the use of intelligence tests in making plans of a relatively permanent nature--that is, covering a period of several years.

Unfortunately, as much cannot be said for tests given during infancy and the preschool period. The age levels for which tests of high predictive value are most needed are the very ones for which we have not yet succeeded in devising such measures. Tests for infants have proved entirely worthless in this respect if prediction of status as long after the initial test as six months or a year is desired. Tests for preschool children are usually positively correlated with tests given several years later, but the magnitude of the correlations is too slight to warrant their use in making future plans for individual children. It was with the hope of improving this situation that the present investigation was undertaken.

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*For a detailed discussion of the many possible interpretations of these changes, see the Thirty-Ninth Yearbook of the National Society for the Study of Education, *Intelligence: Its Nature and Nurture*. Part I, *Comparative and Critical Exposition*; Part II, *Original Studies and Experiments*. Bloomington, Illinois: Public School Publishing Co., 1940.

INTRODUCTION

Practical Need of Predictive Measures

The practical need of intelligence tests that predict future intellectual status and are also suitable for use with young children requires little elaboration. All child placement agencies are aware of this need in connection with their work of (1) placing children for adoption in homes that will give them opportunities for maximal growth and happiness and (2) protecting adoptive parents by giving them children who can make use of the opportunities they have to offer. Underplacement results in waste or distortion of a child's potentialities. Overplacement raises the level of aspiration in both parents and child far beyond what the child can achieve, with consequent disappointment for the foster parents and frustration for the child. Avoiding permanent placement until after children are 6 years of age is obviously undesirable, too. Even under the best conditions institutional life is a poor substitute for home life and a poor preparation for it. Habit training accomplished under the age of 6 has been shown to lay the foundations for the more complex skills and attitudes established later. Parents would be able to make better long-time plans for care and education of children living in their own homes if predictive measures were available before family habit and child reputation become too firmly fixed.

Theoretical Considerations

Two extreme points of view have been expressed concerning the nature of intelligence and of mental organization. One of these, first developed by Spearman in 1904 and described in The Abilities of Man (81), has given impetus to psychological discussion and controversy for the past forty years. According to Spearman and his followers, intelligence as we see it in operation is made up of two components, perhaps three. The first of these has been called "g" and is described as general intelligence, possessed by all individuals in varying degrees and entering more or less into every task that can be said to require intelligent behavior. In addition to the "g" component most tasks require an assortment of "s" factors, or specifics, which vary from person to person and task to task. A third concept in Spearman's theoretical structure is that there may also be group factors, not so general as "g" but tending to function as a unit rather than to break up into separate elements in the way the "s" factors do.

The other extreme point of view is held by Thorndike (91), who considers the task, not the individual, to be the fundamental intellectual unit. According to Thorndike all we have are specifics, an almost endless array of them, capable of infinite combination and arrangement. What correlation we find between two tasks is due to their drawing on the same elements. He would have us speak of "intelligences" rather than intelligence, and describes the intellectual status of an individual in terms of area (altitude multiplied by breadth), i.e., the number of different tasks the individual can successfully perform and the level of difficulty reached by him with respect to each type of task.

Two intermediate points of view, those of Thurstone (89) and Kelley (57), are also worthy of mention. Thurstone comes nearest to Spearman in his basic philosophy, though his mathematical approach is somewhat different. Rather than an all-pervasive "g" factor, he expects to find a number of important group factors, not necessarily completely independent of one another, but relatively distinct. Furthermore, these group factors will arrange themselves in rank order according to their pervasiveness. The means by which they are to be detected are mathematical, and Thurstone's own contribution to that end is presented in Primary Mental Abilities (89), published in 1938. Kelley (57), on the other hand, believes such groups of factors as are to be found are independent of one another and can be isolated in truly "pure" form.

Each of these theorists has his own mathematical techniques (with the exception of Thorndike whose exposition is largely nonmathematical) and none has demonstrated the validity of his views beyond question. A recent discussion of points of divergence and points of agreement between these and other scientists is given by Thomson (88).

At the beginning of the present century in America Cattell (23), Gilbert (37), and others tried out a variety of sensory and sensorimotor tests, but these tests failed to discriminate between bright and dull subjects, whether they were children or adults. American psychologists then turned to translation and restandardization of the Binet tests for use in classifying the feebleminded (38, 74) in clinics studying delinquents, and finally in schools attended by normal children (84). Tests of other types were also appearing, such as performance tests for examination of children and adults with language handicaps (75) and group tests enabling one examiner to test large numbers of individuals at one time (77, 91). America's entrance into World War I greatly accelerated the development of group testing.

INTRODUCTION

Thorndike had been interested in educational measurement for several years, and it was natural that he should turn to the construction of a group intelligence test for the classification of school children (91). The result was one of the most carefully standardized group intelligence tests available at the present time. This test, based on Thorndike's theoretical position, is called CAVD (completions, arithmetic, vocabulary, and directions), and purports to measure four specific mental operations. Cunningham (28) has demonstrated that this test makes mental distinctions even when applied to preschool children.

Binet's scales (17, 16, 15) appear to have been based on the assumption of a "g" factor, and followed years of unsuccessful experimentation with more refined measurements. Demonstration of the presence of a "g" factor in the latest revision of the Binet (84) has been made by McNemar (64), who has presented a series of factor analyses of various age groups, showing a high saturation of the tests with the first factor loading and residuals small enough to be ignored. For purposes of experimentation second and third factor loadings were computed. At the earliest age levels, and to a lesser degree at several other age levels, there was a suggestion of one or more group factors, the most prominent of which was tentatively described as a motor factor. This leads to interesting speculation with regard to the theories of development by individuation and by integration (26). Holding to the former, one might suggest that the group factors originally close to "g" (factor I in the McNemar analyses) become more distinct with the passage of time and hence are not measured to an appreciable extent by the tests at later ages. Shirley's data on the development of 25 babies during the first two years (80), in which the correlation between mental items and motor items was found to be considerable during the first few months and negligible later, might be considered evidence in support of development by individuation, or the result of lack of differential test content at the early ages. On the other hand, the opposite point of view is equally tenable: i.e., that the suggested secondary factors shown at early ages have become integrated with "g" as age progresses and thus the absence of second and third factors at later ages might be explained. Shirley's data might be offered in support of this interpretation also, since she found less stability in pattern at early ages than at later ages for most of the tests given to the babies. All of these interpretations are highly speculative, and it is easily seen that a great deal of work is necessary before the true nature of mental organization can be described.

SELECTING ITEMS IN PRESCHOOL TESTS

From the point of view of prediction it is perhaps not important whether "g" is assumed, or a group of "primary" factors--as long as stability in level of mental functioning is maintained, or at least attributes observable in early childhood can be traced to adulthood. Some authors hold that major changes in mental organization occur after early childhood (3). If such a view is conclusively demonstrated, and if it is found impossible to deduce orderly laws of change, attempts at prediction must be abandoned.

The fact that many test-retest results show higher correlations for short intervals than for long intervals, and the frequency with which irregular growth patterns occur suggest that mental growth is less stable than we once thought and that a good part of the correlation found is due to factors other than intrinsic characteristics of the individual. However, the finding of higher correlation with short intervals between tests than with long intervals is not universal, and there may be several explanations of the fact that the tendency appears in some comparisons and not in others.

Another theoretical aspect of the correlation of measures of mental growth has been pointed out by Anderson (4) and must be taken into consideration in interpreting test-retest data. This is the concept of overlap in the functions being measured. Children rarely lose what they have gained in mental development. At successive ages a greater part of the whole is being measured, the relation of the increment to the whole is smaller, and the relation of the increment to the previously measured portion of the whole is also smaller. When we add to this the variation from year to year in the amount of overlapping content of the tests (greatest at later ages, of course) and the uneven reliabilities of tests (greatest at the younger ages), the complexity of the problems yet to be solved becomes apparent.

It is hoped that the perspective gained by even this brief view of the theoretical background of mental measurement shows the true significance of the problem of prediction. No matter how urgent may be the practical problems that tests of high predictive value will help to solve, the major contribution of such measures will be their use as tools for testing the divergent points of view concerning the nature of intelligence.

II. THE PROBLEM

Tests for Infants and Preschool Children

Binet's 1905 scale contained some items suitable for use with children of mental ages lower than 6, but these items were not standardized on preschool children and there were too few of them to provide an adequate estimate of the abilities of normal preschool children. Several physicians (25, 79) and many of the baby biographers (76, 78, 92) described tasks assumed to be indicative of mental development in young children, frequently suggesting age norms for them. Kuhlmann (59) was the first to devise a standardized scale in terms of quantitative units, beginning with the 3-month age level and providing tests at 6, 12, 18, and 24 months, and at each year of age thereafter through 11 years. Two more age levels, 13 and 15, complete this scale. Since the publication of the Kuhlmann-Binet scale in 1922 a number of tests for infants and preschool children have been developed. One of the principal workers in this field is Arnold Gesell of Yale University, who since 1925 has published a series of books on mental growth, including several which give an item-by-item description of the content of his developmental schedules (34, 35, 36). He has not limited his schedules to the measurement of intelligence, however, and he has not developed a completely quantitative score. Table 1 summarizes the pertinent information concerning the better known tests for infants and young children available at the present time. All tests devised since the early work of Binet, Kuhlmann, and Gesell have drawn heavily upon test items originated by them. Each investigator has added a few items and has revised procedures for administration and scoring.

The Predictive Value of Tests for Infants and Preschool Children

Table 2 summarizes studies made of the reliability, validity, and predictive value of these scales beyond their standardization data. Many of the correlations between tests of infants and retests given several years later are seen to be of zero order or slightly minus.* Apparently either the test content of infant scales is not suitable for predictive

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*For a discussion of possible explanations of these minus values, see Goodenough, F.L., and Maurer, K.M., *Mental Growth of Children from Two to Fourteen Years*. Minneapolis: University of Minnesota Press, 1942, p. 14.

Table 1--Tests for Infants and Preschool Children[*]

Author	Name of Test	Date	Ref-erences	N	Ages (Months)	Population	Criteria for Test Selection, Validation of Scales, Reliabilities
Terman, L.	Stanford-Binet	1916[†]	84	99 under 6 years	36-71+[‡] tests at 3-, 4-, and 5-year age levels	California. Unselected school children (foreign-born eliminated) tested within two months of birthdays	1. Percentage passing at successive ages (discriminative value) 2. Comparison of each test with total scores (IQ) of three contrasted groups (inferior, average, superior) Validity: 1. Comparison of IQ's with school grade 2. Comparison of IQ's with teacher's ratings (+.48)
Kuhlmann, F.	Kuhlmann-Binet	1922	59	455 under 6 years	3-71+	Minnesota. Public school children, orphanage, and "baby contest" children (slightly superior sampling--scores adjusted)	1. Percentage passing at successive ages--also percentage of improvement on time and error scores. 2. Comparison of each test with total scores (IQ) of bright and dull groups
Yerkes, R., and Foster, J.	Infant Point Scale	1923	98	300 under 6 years	36-71+ tests at ½-year age levels	Massachusetts. Day nurseries, settlement house nursery schools, surgical cases of children's hospital	1. Percentage passing at successive age levels, using partial credits rather than + or - only Tentative norms only

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[*] Tests are arranged in chronological order. A number of single tests and partially standardized groups of tests (mostly performance material) have been omitted for the sake of brevity. Tests applicable at kindergarten age for normal children have been ignored here as covering too brief a part of the range under consideration.

[†] Preliminary published work is indicated in reference numbers with three exceptions: preliminary work of Terman, Kuhlmann, and Gesell was considered important enough for inclusion. Later scales by Terman and Merrill and by Kuhlmann have been sufficiently revised to be considered "new" tests. Gesell's later work is indicated in references: Though a great deal of improvement and further subdivision to include more ages has been accomplished, quantitative scores are still lacking.

[‡] Plus (+) after ages in the table indicates that the scale continues at ages beyond 6, but later age standardization has not been discussed in the table.

Table 1--Continued

Author	Name of Test	Date	Ref-erences	N	Ages (Months)	Population	Criteria for Test Selection, Validation of Scales, Reliabilities
Gesell, A.	Developmental Schedules	1925	34 35 36	? 50 at each age level	4-60 "norms" for 4-, 6-, 9-, 12-month levels; 2-, 3-, 4-, 5-year levels	Connecticut. Children under 2 years from well-baby clinics; children from 2 to 5 years old solicited from their homes (an attempt made to avoid extremes)	1. Percentage passing at successive ages Not a mental test only--items grouped at (1) motor, (2) linguistic, (3) adaptive, and (4) personal-social "Norms" descriptive only--no quantitative scores Item source for many scales
Linfert, H., and Hierholzer, H.	A scale for measuring mental development during the first year of life	1928	62	300 50 at each age level; 1, 2, 4, 6, 9, and 12 months	1-12	Washington, D.C. Children from two maternity hospitals and an infant orphan home. Tested within 5-7 days of monthly birthdays. Average S-E status (Sims Score Card)	1. Percentage passing at sucessive ages Reliability: (split-half) +.70+ +.88 (med. +.85) Validity: Slight relation to S-E status Two scales: 1-5 months; 6-12 months
Hallowell, D.	Mental tests for preschool children	1928	45	657 under 4 years	12-47	Pennsylvania. 25% from homes of high intellectual status; 11% from well-baby clinics; 23% from day nurseries; 11% from institutions; 30% from child-placing agencies	1. Percentage passing at successive ages
Atkins, R.	Object-fitting test. Forms A and B	1931	7	? 150 at each age level	24-60	Minnesota. From nursery schools, child care agencies, and siblings of school children--matched to Minneapolis Fathers' Occupational Status (cases of extreme negativism excluded)	1. Percentage passing at successive ages (Woodrow D.V. Formula) 2. Degree of overlap from age to age Reliability: Form A correlated with Form B +.79 to +.96 Validity: Comparison with Minnesota Preschool Scale: +.52, +.87, +.78 for 2-, 3-, 4-year levels (Not recommended for 5-year-olds) Scores related to S-E status

Table 1--Continued

Author	Name of Test	Date	Ref- erences	N	Ages (Months)	Population	Criteria for Test Selection, Validation of Scales, Reliabilities
Stutsman, R.	Merrill-Palmer Scale	1931	82	631 approximately 60 at 6-month intervals	18-77	Michigan. Merrill-Palmer School waiting list; public and private schools; child care agencies; health clinic groups	1. Percentage passing at successive ages 2. Degree of overlap from age to age 3. Comparison with C.A. +.92 Validity: 1. Slower increase in score for feebleminded group 2. Comparison with nursery school teachers' ratings 3. Comparison with Stanford-Binet for group 3-6 years of age +.79 Thurstone's scaling method
Goodenough, F., Foster, J., and Van Wagenen, M.	Minnesota Preschool Scale Forms A and B	1932	43 44 42	900	18-71	Minnesota. From settlement house nursery school, other nursery schools, city block survey, infant welfare clinics--matched to Minneapolis Fathers' Occupations	1. Percentage passing at successive ages 2. Equivalent items available for Forms A and B 3. Each item compared with total score Reliability: 1. Form A correlated with Form B. (N + 450) +.85 to +.92 (Med. +.89) for total scale Validity: Related to fathers' occupational level Verbal, nonverbal, and total IQ equivalents
Bayley, N.	California First Year Mental Scale	1933	11	61 Longitudinal study (46-61 at each level)	1-21, 1-15, 18, and 21	California. Slightly superior to population of Berkeley	Reliability: (split-half) +.51 to +.95 (Med. +.85)

Table 1--Continued

Author	Name of Test	Date	Ref-erences	N	Ages (Months)	Population	Criteria for Test Selection, Validation of Scales, Reliabilities
Jaffa, A.	California Preschool Scale Forms A and B	1934	52	?	?	California. Berkeley children	No standardization data given; material divided into ten categories at each age level--an attempt to test same functions at each level
Bühler, C., and Hetzer, H.	Baby-Tests See Herring's results (Table 2) regarding applicability to American children	1935	19 20 21	440 under 6 years	1-71+ Tests at 1-8, 9-10, 11-12, 13-15, 16-18, 19-24 months; 3, 4, 5. and 6 years	Austria. Poor population of Vienna: children's homes, public kindergartens and schools, maternity hospital	1. Percentage passing at successive ages
Fillmore, E.	Iowa Tests for Young Children	1936	32	643	1-40	Iowa. Health clinic, house-to-house survey in the country, volunteers	1. Percentage passing at successive ages 2. Comparison of each test with highest and lowest thirds on total score Reliability: (split-half) +.88 to +.93 Validity: Comparison with "nearest" Stanford or Kuhlmann-Binet (correlations very low for both total score and individual items)
Terman, L., and Merrill, M.	Revised Stanford-Binet Forms L and M	1937	86	670 under 6. 74-110 at each ½-year level	18-71+ Tests at ½-year intervals	17 communities in 11 states. Siblings of school children, kindergarteners, others from well-baby clinics, day nurseries, and settlement house nursery schools—matched to school population and U.S. for fathers' occupations (too high under 4 years--adjustment made in scores)	1. Percentage passing at successive ages 2. Equivalent tests for two forms 3. Sex differences and practice effect studied 4. Each test compared with total score (IQ) and with 1916 scale Reliability: Varies with IQ level, +.83 to +.92 for ages 2½ to 5½ (McNemar) Validity: 1. Related to S-E status 2. Related to 1916 scale and other intelligence tests

Table 1--Continued

Author	Name of Test	Date	Ref-erences	N	Ages (Months)	Population	Criteria for Test Selection, Validation of Scales, Reliabilities
Kuhlmann, F.	Kuhlmann-Binet	1939	61	973 under 6 years	6-71+	Minnesota. School children selected from "representative" towns; preschool children from birth records of these and other towns	1. Increase in raw score with age 2. Percentage passing at successive ages 3. Variability from age to age 4. Each test compared with total score (IQ) Uses Heinis Personal Constant rather than normal curve
Cattell, P.	Infant Intelligence Tests	1940	24	274 Longitudinal study	3-36 Children tested at 3, 6, 9, 12, 18, 24, 30, and 36 months	Massachusetts. Harvard Growth Study--Normal Child Series Superior Group (M = 118 IQ on Stanford-Binet at 36 months)	1. Percentage passing at successive ages Reliability: (split-half) +.56 to +.90 (Med. +.87) Validity: Correlations with Stanford-Binet at 36 months vary from +.10 at 3 months to +.83 at 30 months

Table 2--Critical Evaluations and Predictive Studies*

	Identification			Sampling				Findings	
Author	Date	Reference	Tests Used	N	Ages (Months)	Population	Age Test 1	Interval	Findings
Terman, L.	1919	83	Stanford-Binet	99	36-71	California. Vicinity of Stanford Univ.	. . .	1 day to 7 years	Range of change +20 to -20 8% changed 20 points or more
Baldwin, B., and Stecher, L.	1922	8	Stanford-Binet	59	24-84	Iowa Univ. Preschool	. . .	3 to 20 mos.	17% changed 15% or more of first IQ
Woolley, H.	1925	97	Stanford-Binet	a)43 b)36	30-60	Michigan. a) Merrill-Palmer School b) Waiting list	. . .	7 to 14 mos.	Range of change -40 to +40 Percentage of changes: a) 43%, 20 points or more b) 22%, 20 points or more
Johnson, B.	1925	53	Stanford-Binet	125	24-96	New York. Public and private schools	. . .		r = +.80 18% changed more than 10 points Range from -17 to +32
Hildreth, G.	1926	47	Stanford-Binet	132	36-60	New York City children	. . .		4.3% of children over 6 changed 20 points or more 19% of children under 6 changed 20 points or more
Goodenough, F.	1928	39	Kuhlmann-Binet	a)300 b) 56	24, 36, and 48	Minnesota. Matched to occupational class of fathers	. . .	a) 5.9 weeks b) 1 year	a) r = +.82 b) Older group, r = +.84 Younger group, r = +.76 4% changed 25 points or more Average change, 8.5 points

*This table does not include studies reported in the Thirty-Ninth Yearbook of the National Society for the Study of Education, since it is of recent publication and readily available.

Table 2--Continued

	Identification			Sampling				Findings	
Author	Date	Reference	Tests Used	N	Ages (Months)	Population	Age Test 1	Interval	Findings
Conger, J.	1930	27	Linfert-Hierholzer for babies; Stanford-Binet and Arthur for mothers	25	1-3	Minnesota. Babies and their unmarried mothers	. . .	1 and 2 mos.	2 tests on successive days at 1, 2, and 3 months: 1 month r = -.24 ±.12 2 months r = +.44 ±.11 3 months r = +.69 ±.07 Odd-even reliability +.16 to +.71 No relation between 1 and 2 months' tests or 1 and 3 months' tests; r between 2 and 3 = 1.05 No relationship to mothers' IQ
Stutsman, R.	1931	82	Merrill-Palmer	a)77 b)77 c)207	2 to 5 years	Michigan. Merrill-Palmer standardization group (See Table 1)	. . .	a) 2 mos. b) 6-9 mos. c) 6-9 mos.	a) r = +.72 (tests 1 and 2) b) r = +.71 (tests 2 and 3) c) r = +.59 (tests 1 and 3)
Furfey, P. H., and Muehlenbein, J.	1932	33	Linfert-Hierholzer and Stanford-Binet	81 tests 71 cases		Washington D.C., standardization group (See Table 1)	6, 9, 12 mos.	4 years 4 years 4 years	r = -.11 ±.13 (N = 27) r = -.34 ±.11 (N = 26) r = -.20 ±.12 (N = 28) Total r = .00 ±.07 (N = 81) Gain or loss in IQ correlated with Sims score card, r = +.33 ±.07
Updegraf, R.	1932	93	Kuhlmann-Binet and Stanford-Binet used separately	a)63 b)123 c+d)71	19-66	Iowa Univ. Preschool	. . .	a+b) 6 mos. c+d) within 1 year	a) r = +.54 (1st test before school entrance) b) r = +.84 (1st test after school entrance) c+d) r = +.72
Mowrer, W.	1933	67	Stanford-Binet	95	20-66 (approx.)	Maryland. Johns Hopkins Child Institute	. . .	12.7 mos. average	Range of changes, -24 to +29. Average change, 13.7 points

Table 2--Continued

Author	Identification			Sampling				Findings	
	Date	Reference	Tests Used	N	Ages (Months)	Population	Age Test 1	Interval	Findings
Bayley, N.	1933 1939 1940	11 14 12	California First Year Scale	61	21, 24, 27, 30, 36	California. Berkeley children, slightly superior	. . .	3 mos. 6 mos.	r = +.82 (average) r = +.79 (average) 25% changed 10 or more IQ points after an interval of 1 year; 25% changed by 17 or more points after 3 years
Driscoll, G.	1933	30	Kuhlmann-Binet	a)109 b)91 c)38 d)23	12-48	New York City. Teachers College Child Development Institute	. . .	6 12 18, 24 mos.	r = +.61 r = +.60 r = +.56 r = +.60 Range of changes, -40 to +51
			Merrill-Palmer	a)37 b)47 c)33 d)16	24-48			Same	r = +.56 r = +.54 r = +.60 r = +.39 Range of changes, -22 to +44
			Merrill-Palmer and Kuhlmann-Binet	a)53 b)71 c)85 d)54 e)30	24-48			Same	r = +.63 r = +.64 r = +.70 r = +.55 r = +.76 Range of changes, -64 to +42
Kawin, E.	1934	56	Stanford-Binet and Merrill-Palmer used separately	a)114 b)39 c)39 a)169 b)56 c)56	26-90	Illinois. Chicago nursery schools, 90% of cases; clinic cases, 10%	. . .	a)10.6 mos. b)11.6 mos.	a) r = +.75. Average change 9.1 points; range, -34 to +40 b) r = +.84. Average change 7.6 points; range, -23 to +20 c) r = +.75 (1st and 3rd tests) a) r = +.59. Average change, Sigma score, 0.78; range, Sigma score, -2.4 to +3.2 b) r = +.57. Average change, Sigma score, 0.64; range, Sigma score, -1.9 to +1.7 c) r = +.49 (1st and 3rd tests)

Table 2--Continued

Author	Identification			Sampling				Findings	
	Date	Reference	Tests Used	N	Ages (Months)	Population	Age Test 1	Interval	Findings
Herring, A.	1937	46	Bühler Baby Tests	114	1-11	Fairly representative of Minneapolis occupational classification	1; 5-6; 9-10 mos	4-5 mos. 8-9 mos.	Split-half reliability, r = +.85 on 1st test; +.87 on 2nd test Test-retest reliability, r = +.78 1 to 5 and 6 months, r = +.29 1 to 9 and 10 months, r = +.35 5-6 to 9-10 months, r = +.47
Wellman, B.	1938	95	Merrill-Palmer;	a)44	20-62	Iowa Univ. Preschool 208 cases; Iowa Teachers College Preschool 11 cases; orphanages, 62 cases	28-60 mos.	a) 1 week	a) r = +.92
				b)127				b) 5-7 mos.	b) r = +.54
			Merrill-Palmer and Kuhlmann-Binet	c)53			18-63 mos.	c) 11-13 mos.	c) r = +.50
				a)24					a) r = +.47
				b)24				b) 30-41 mos.	b) r = +.66
				c)70				c) 18-29 mos.	c) r = +.49
				d)75				d) 6-17 mos.	d) r = +.55
Honzik, M.	1938	50	California Preschool Schedules 1 and 2, and Stanford-Binet	252		Representative sample of Berkeley, California	21 mos.	6 mos.	Test-retest r = +.71; decrease with increased interval r = +.17 to +.32 (1st test and Stanford-Binet) children under 3 Tests at 3 years and above, r with Stanford-Binet = +.55 to +.76
Anderson, L. D.	1939	5	Items from Gesell, Buhler, Linfert-Hierholzer, and others; Stanford-Binet at 5 years	91		Ohio. Children enrolled in developmental health inquiry at Brush Foundation	3 mos.	3, 6, 9, 12, and 6-month intervals to 5 years	Through 12 months, r's zero or minus For 18 months, r = +.23 For 24 months, r = +.45 Selected items improved r's slightly Using all tests from 3 through 24 months plus parent education, r = +.71 Using all tests from 3 through 24 months, r = +.64

Table 2--Continued

Author	Identification			Sampling				Findings	
	Date	Reference	Tests Used	N	Ages (Months)	Population	Age Test 1	Interval	Findings
DeForest, R.	1941	29	Merrill-Palmer and a) Stanford-Binet Minnesota b) and Stanford-Binet	170 44	24-63	Nursery school, slightly superior	. . .	1 to 88 mos. Same	a) r = +.55 for total age range b) r = +.56 for total age range Minn. nonverbal IQ lower correlation with Stanford-Binet; verbal IQ correlation with S-B similar to total IQ's and Merrill-Palmer's Length of interval not significant for Merrill-Palmer and Stanford-Binet for prediction
Katz, E.	1941	55	Stanford-Binet	308	3-5 years	Somewhat superior; fathers professional and business	3 years	6 months	r's from +.53 to +.77 inversely related to interval between tests, not related to age 40% show changes of 20 or more points from 3 to 5 years
Goodenough, F., and Maurer, K.	1942	42	1 Minnesota 2 Minnesota and Stanford-Binet (1916); 3 Stanford-Binet (1937); 4 Merrill-Palmer; 5 Arthur; 6 A.C.E.	a)130 b)135 c)241	18-71 18-71	Minnesota Mental Growth Study; superior	a)under 36 b)36-47 c)over 47 mos. a)under 48 b)48-59 c)60-71 mos.	. . .	1 a and b, r = +.45; a and c, r = +.53; b and c, r = +.67 2 a and b, r = +.45; a and c, r = +.64; b and c, r = +.68 3 a and b, r = +.21; a and c, r = +.61; b and c, r = +.68 4 a and b, r = +.29; a and c, r = +.22; b and c, r = +.22 5 a and b, r = +.31; a and c, r = +.51; b and c, r = +.46 6 a and b, r = +.12; a and c, r = +.29; b and c, r = +.39

Table 2--Continued

Author	Identification			Sampling				Findings	
	Date	Reference	Tests Used	N	Ages (Months)	Population	Age Test 1	Interval	Findings
Ackerman, D.	1942	1	Bühler Baby Tests	200	7-12	Representative sampling, New York City	. . .	. . .	Reliability for combined groups, r = +.98 Revision of items suggested on basis of percentage passing all items at own age level 2 DQ's for each child computed on odd-even items, averaged, yield r = +.94
Ebert, E., and Simmons, K.	1943	31	Stanford-Binet	181	3-10 years	Brush Foundation, superior socio-economic status	3-9 years	6 months; 1 year after age of 5	Slight relationship to mother's education at older ages Intercorrelations from +.50 (3 and 10) to +.86 (8 and 10) The longer the interval and the earlier the age, the lower the correlation Same trends from cross-sectional study
			Merrill-Palmer	223	2-4 years		2-3½ years	6 months	
			Merrill-Palmer and Stanford-Binet;	447					Intercorrelations show inverse relationship to interval and slight relationship to age at first test
			Merrill-Palmer and Stanford-Binet (at later ages);	43-151 (in sub-groups)	2-11 years			Same age	Sex differences at early ages favor boys r = +.60
			Merrill-Palmer and performance materials		2-11 years				r's from +.41 to +.54, decreases with increased interval r from +.28 to +.60

purposes or mental organization is not stable at these ages. From 18 months of age on, the correlations are positive but until about 4 years of age they are very low. After this time the test-retest correlations are generally high enough to be useful, though interpretations must still be made with great caution. A summary and detailed discussion of the predictive value of tests for infants and preschool children is given in *Mental Growth of Children from Two to Fourteen Years* (42) published in 1942, and need not be repeated here.

Attention is called, however, to the correlations presented by Bayley (13, 14, 12), Honzik (50), Goodenough and Maurer (42), and Ebert and Simmons (31). (See Table 2.) Honzik studied more than 250 children, who were given repeated tests using the California Preschool Schedules I and II (adapted from the California Preschool Scale, Form A) at ages from 21 months through 5 years and the 1916 Stanford-Binet at ages 6 and 7. Her data show the relationship between later standing and age at first test and interval between tests which has been mentioned by a number of other investigators: (1) the younger the child at the first test, the lower the test-retest correlation, and (2) the longer the interval between tests, the lower the correlation. By use of the formula $\frac{\text{CA at first test}}{\text{CA at second test}}$ Honzik was able to show the effects of age and interval separately. She found the test-retest correlations of her study to be affected by each of these factors when the other was held constant. Bayley (13, 14, 12) has also reported this to be the case with repeated tests on the same group of 61 children whom she studied from 1 month of age through 10 years. The predictive studies of the Minnesota investigation (42) show the usual relationship between standing on retest and age at first test, but the interval between tests does not seem to affect the test-retest correlations in any systematic fashion, whether the Minnesota Preschool Scales (44) are compared with later testings on the same scales or on any of the following: 1916 or 1937 revisions of the Stanford-Binet (84, 74), the Merrill-Palmer Performance Tests (82), or the Arthur Performance Scale, Form I (64). In a recent monograph Ebert and Simmons (31) present test-retest comparisons on large numbers of cases studied at the Brush Foundation of Western Reserve University. Section I of this report gives results for children tested on the 1916 Stanford-Binet from 3 to 7 years, on the Revised Stanford-Binet from 6 to 11 years, and on the Otis Self-Administering Intelligence Test at 12 years of age. Section II compares

Merrill-Palmer Performance Tests at 2 to 4 years of age with retests given at intervals of from ½ to 1½ years, with Binet tests given at the same ages and later, and with several individual performance tests given at later ages. The Stanford-Binet comparisons show decreasing r's with increasing intervals, and lower r's for earlier than for later ages at first test. The Merrill-Palmer comparisons also show decreasing r's with increasing intervals between tests, but fail to show a consistent trend with regard to age at first test. When the Merrill-Palmer is compared with retests on the performance materials the effects of these two factors are present but very slight. Discrepancies among the findings of these four studies mentioned above are discussed in connection with the results of the present investigation.

A comparison of Tables 1 and 2 makes it apparent that (1) the predictive value of many tests used for young children has never been ascertained, (2) the studies that have been made show a disappointing lack of positive correlation between early standing and later standing when the intervals between tests are long enough for such information to be useful, and (3) with the exception of three studies (5, 64, 70, 71, 72), no statistical analyses of separate items have been made to find out which are valid for purposes of prediction, or to obtain a clearer definition of the nature of intelligence and mental growth.

Criteria for the Selection of Items in Tests for Young Children

In an article on the predictive value of tests for infants and young children, Anderson (4) lists the criteria of item selection employed in the construction of intelligence tests in general since the original Binet-Simon Scale. These are: (1) progression with age in the percentage of children passing a given test item, (2) internal consistency as determined by the correlation of the individual items with the total score, (3) correlation of test results with teachers' ratings of intelligence, and (4) correlation of test results with records of academic achievement. As Anderson has pointed out, the only one of these criteria used consistently is progression with age in the percentage of children passing the item. (See Table 1, column 8.) The selection of items that are passed by increasing percentages of children at successive ages makes it possible to place them properly in a scale of increasing difficulty. It is also logical to include only items which show increasing percentages passing with age in a scale which purports to measure a function assumed to increase with age, although "this requirement in and of itself does not guarantee validity" (McNemar, 64, p. 83). Perhaps we should not blind ourselves at this point to the possibility that there might be items of predictive value that are not passed by increasing percentages at successive ages. Many test makers exclude all items which do not show a marked increase in the percentages passing with small increments of age. It is possible that valid items are sacrificed by too rigid adherence to this rule. We have no reason to believe that all testable mental functions grow at exactly the same rate and over the same span of years; in fact, there is some evidence to the contrary. Also, it is possible that there are certain qualitative differences related to intellectual status at maturity which are not related to mental age. That there are qualitative differences between individuals of the same mental age but different chronological ages, and hence different levels of intelligence, has been demonstrated by Aldrich and Doll (2), who compared infants and idiots; by Merrill (65), who compared children of the same mental age but three different levels of chronological age; and by Cunningham (28), who compared adult imbeciles and preschool children. If one is ignorant of the predictive value of the total score, a measure of internal consistency throws no light on the validity of a test for predictive purposes. The last two methods of selecting items are obviously unsuitable for children who have not yet had school experience. Something may be learned concerning the intelligent behavior of preschool children by analysis of nursery school teachers' ratings together with a careful description of the basis of such ratings. Binet used a similar method with elementary school teachers to secure items for his scale. Further analysis would be required, however, to establish the predictive value of such items of behavior. If teachers, or anyone else dealing with young children, could tell by observation how the children were going to turn out, intelligence tests would not be needed as an aid in making plans for them. A further method sometimes used in validating intelligence tests is correlation with some other measure of intelligence. This is a somewhat circular method of reasoning at best, and not at all suitable for use at ages for which no measure of intelligence has been satisfactorily validated up to the present time.

Anderson (4) suggests that, since our primary interest in testing young children is terminal status, we use a measure of terminal status as a criterion for the

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selection of test items. A beginning in the direction of item analysis, in which the Stanford-Binet standing at the age of 5 is the criterion, has been made by L. Dewey Anderson (5). Nelson and Richards (70, 71, 72) analyzed Gesell items at 6, 9, and 12 months, using Merrill-Palmer standing at 18 and 24 months and Stanford-Binet standing at 36 months as criterion scores. Results of these two researches will be compared with the items selected in this study. Though the method is similar, obviously the intervals are too short to throw light on the present problem—predicting intellectual status at maturity. Factor analysis of test items has been used as a method of defining the abilities measured by intelligence tests for older children in a number of investigations (66, 69). The outstanding work in this area is that of Thurstone (89) described in Primary Mental Abilities, 1938. At present Thurstone is extending his work to earlier age levels. As far as I know, these are the only published studies using this method on tests for infants or preschool children. In one, McNemar (64) presents a series of such analyses on overlapping portions of the entire population on which the 1937 Stanford-Binet scale was standardized. The other is the Nelson and Richards (71) factor analysis of items given the Fels group at 6 months of age. These studies are referred to in the chapter on results.

In order to make use of a terminal status criterion, longitudinal data are required; that is, a measure of final status on a group of young adults for comparison with tests given them at preschool ages. Preschool test data on a group of subjects approaching adulthood were available from the files of the Institute of Child Welfare at the University of Minnesota. The present study is an attempt to test the value of terminal status as a criterion of item selection.

The Minnesota Mental Growth Data

The collection of mental growth data at the Institute of Child Welfare at the University of Minnesota was started in 1926, when work was begun on the Minnesota Preschool Scales (44). A recent monograph (42) describes this longitudinal study: the standardization of the scales, and a series of predictive studies (summarized in Table 2) comparing the scales with retests and with a variety of other tests given at later ages. When the Minnesota Preschool Scales were constructed it was believed, largely on the basis of literature describing test items for school children, that tests of a verbal nature were the most valid tests of intelligence for younger children. Accordingly, verbal tests were twice as heavily weighted as nonverbal items in the total score. Also, there were more verbal items that met the criteria for the selection of items for the scales, and the reliabilities of verbal items were slightly higher than those of nonverbal items. However, predictive value of the nonverbal items proved to be as high as and in some cases higher than that of the verbal items. This suggests that what appears to be the best item on the basis of analysis made at the time of test construction may not be the best item from the point of view of prediction of future mental status. Therefore, I decided to use the method suggested by Anderson to try to identify those tasks with the highest predictive value, to weed out the noncontributing items, and to form some idea as to the nature of the items that should replace the poor ones.

Sixteen years had elapsed since the beginning of the Mental Growth Study. I decided to attempt to locate as many as possible of the young people who had had Minnesota Preschool tests during early childhood, to retest them to determine their terminal intellectual status, and by working backward to discover which items on the preschool tests had predicted their mental status at the time of the present study. Such items and others similar to them could then be used for a new scale of higher predictive value. Why such a study had not already been made is easily explained. With the possible exception of the records referred to by Wellman (94) on children who attended the University of Iowa nursery school and who are now of college age, I know of no longitudinal records that compare in length with those made available by retesting individuals studied as early as 1926 at Minnesota.

The Choice of a Measure of Terminal Status

It has always been easier to study the intelligence of school children than that of other age groups. They are easily obtained for testing, are as a rule not too resistant, and various supplementary facts that aid in securing a reasonably good sampling are known concerning them. The construction and standardization of tests at either extreme, preschool age or adult level, have been more difficult, and results of such testing are correspondingly difficult to evaluate. Choosing a measure of terminal status, therefore, was not an easy task.

By far the widest sampling of adults ever tested was the soldier population given the Army Alpha Test (99) during

World War I. It was finally decided to use the Wells (96) revision of this test as the primary measure of intellectual level at maturity. A group test seemed desirable, since I hoped to test several hundred subjects. Most of the other group tests, such as the college aptitude tests, were either limited in scope, or had ceilings too low for adults known to be mentally superior.* On the other hand, in order to have a range of ability wide enough to make discrimination possible, it was desirable that not all subjects be in college or preparing for college. The college aptitude tests are built upon a conception of intelligence tied up with academic training, interest, and potential success--as they should be to serve the purpose for which they were constructed. A somewhat wider conception of intelligence is required for the purposes of this study. A test was needed that did not place too great a premium on academic pursuits or ambitions, but rather measured general all-round intellectual functioning, one of the essentials to successful personal and social adjustment in a complex society such as ours. The Alpha test seemed best for this purpose. It also had the advantage of norms based on the general population. The revision is not very different from the original test of 1918. The first test in the 1918 battery, a test of following directions which was confusing, has been replaced by one of simple addition which seems to be satisfactory in securing the desired mental set. All content of the earlier test that refers to the war or is otherwise dated has been replaced by similar items which are more appropriate. Essentially the nature of the test has not been altered. This revision was especially planned to have a ceiling high enough for superior adults and still be suitable for use with persons of much less ability.

Other data lending some light on terminal status were available on various groups of subjects and have been recorded for supplementary use. Since these data were not available on all subjects, a further advantage of using the Alpha test was to have one measure common to all of them. An Interests Questionnaire, given to each subject at the time of taking the Alpha test, provided further material in support of the Alpha scores as valid measures of intellectual status at maturity.

The additional measures available on some of the subjects were: (1) number of years of schooling completed;

An increasingly superior group was available for retests in the predictive studies previously reported. It was to be expected that this trend in selective elimination of cases would continue.

(2) scores on 1916 and 1937 revisions of the Stanford-Binet between the ages of 11½ and 15½; and for those who had reached their senior year in high school, (3) high school percentile ranks, based on grades; (4) score on the American Council of Education Psychological Examination (1937); and (5) standing on the Cooperative English Test (1937-38: Form OM).

Years of education completed, while interesting supplementary material, could not be used as a measure of terminal status, since many of the subjects had not completed their education. Even for those who had left school only a very crude result could be obtained by trying to evaluate education in vocational high schools, finishing schools, and business colleges. The present writer would not even attempt to evaluate the special training programs in the services to which many of the boys were transferred from high school or college.

The American Council of Education Psychological Examination (90) and the Cooperative English Test (73) were given only to seniors in high school and were of the type mentioned above as being too limited in scope for this study. Identical high school percentile ranks have widely different meaning in different schools and, since there is no way of evaluating the schools, cannot be used here. (Percentile ranks do not lend themselves to most types of statistical treatment.)

A special terminal status group of subjects who were given Stanford-Binet tests between 11½ and 15½ but who could not be located for retesting on the Alpha test was employed as a further validation group. The items selected by use of the Alpha test as a criterion were correlated with the Binet score. The score on the last Binet test given was used as the measure of terminal status. This group was kept separate from the primary terminal status group, since the ages at which these tests were given were not high enough to represent terminal status adequately.

In one respect even the Alpha test proved to be somewhat disappointing as a measure of terminal status. A tendency for increase of score with age was found even after 16½ years, complicating the problem of presenting the results. Terminal status, at least for the group studied here, had not been reached by the age of 16½ years. This is not surprising in the light of findings of other investigators using a number of different tests (91, 18, 54), who report continued mental growth after this age. However, the increments after 16½ years in relation to the total mental growth curve are small enough to be ignored for the major purpose of this study--the evaluation of the criterion for future application.* If the hypothesis is even partially supported by the present investigation, a later study with a more adequate measure of terminal status and a more representative sample will make even finer discriminations between those items that have high predictive value and those that have not.

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*Thorndike (91) has estimated that approximately 98 per cent of mental growth takes place before 16½ years of age.

III. THE SUBJECTS OF THE TERMINAL STATUS STUDY

Locating the Subjects for the Follow-Up Study

An effort was made to locate in the Mental Growth Study files the records of all subjects 16 years of age or older in June 1942 who had taken at least one Minnesota Preschool Scale (44) before the age of 6 years. There were 1091 records in the files of subjects between 16 and 22 years of age, according to their recorded birth dates, who had been given at least one Minnesota test. In many instances they had been given several Minnesota tests at different ages as well as Kuhlmann-Binet (59) and Merrill-Palmer (82) tests during the preschool period.

Of the 1091 records that met the initial criteria of selection, age, and preschool testing, 26 were not sufficiently complete to permit identification of the subjects. They had been tested while attending settlement-house nursery schools, and their parents' names had not been accurately recorded or proved to be aliases. Sometimes children had been placed for adoption, their contacts with social agencies terminated, and their names changed. Seventy-four more were unavailable for retesting because they had moved away, a notation to that effect having been made on the record. This left a total of 991 entries on the master list, which included full names, birth dates, parents' names, last recorded addresses, and telephone numbers if any were listed on the records.

In order to locate as many of these persons as possible, the parents' names were first checked against the telephone directories of Minneapolis and St. Paul and their suburbs, and then against the city directories of both cities, if they were not listed as having telephones. Appointments were made by telephone if possible. An explanatory letter was sent to those listed only in the city directories, enclosing a return postcard on which were listed several testing appointments. The recipient was asked to check the testing date most convenient for him. If he was interested in cooperating in the study but could not come at any of the testing periods designated, he was asked to call for a more convenient appointment. Several took the trouble to do so. If there was no response to repeated telephone calls, a letter was sent to the latest address recorded. Many of these letters were returned by the post office, marked "Not Here."

SELECTING ITEMS IN PRESCHOOL TESTS

From June 1942 to January 1943, approximately six to twelve months after the United States entered the war, the population of the Middle West was shifting rapidly. Many persons whose names were listed both in telephone directories and city directories could not be contacted because they had left since the directories had been published. In some cases the wage earners of these families had taken defense jobs in other parts of the country. A number of cards were sent back from the East and West coasts, a few from the South. Some of the fathers of the boys and girls on the list and some of the boys themselves were already in the service, and in some instances the whole family had consequently changed its place of residence. With each succeeding month after the list was compiled in the summer of 1942, increasing numbers of persons were eliminated for these reasons. The families of 654, or 60 per cent of the total number meeting the requirements for selection, could not be identified, or located, or were known to have moved away.

The Persons Whose Families Were Contacted

Of the remaining 437 persons whose families were contacted, 226, or about 52 per cent, were retested. Several had died or were too ill to take the test. The others were either in the armed forces, away from home at school or work, unable to find the time to come in, or unwilling to cooperate. Table 3 gives the number and percentage of the total number of persons whose families were contacted in each of these categories.

Table 3--Classification of Persons Whose Families Were Contacted

	N	%
In the armed forces	59	13.5
Away from home	19	4.3
Unable to come	75	17.2
Uncooperative	58	13.3
Tested	226	51.7
Total contacted	437	100.0

In order to obtain maximum cooperation at a time when people in general were unusually busy and preoccupied with more immediate problems, testing dates were made at any time that suited the convenience of the subjects. Many of the young people in high school and college were carrying part-time jobs. Some of them were carrying several jobs besides going to school and engaging in extracurricular activities. Since a large number were employed in defense plants on shifts that made it impossible for them to come in during the usual office hours, much of the testing was done in the evening. Several were interested enough to come on Sunday afternoons when there was no other time free on their schedules.

A group test was selected as the measure of terminal status in order to test as large a number as possible within reasonable limits. However, it was not possible to make appointments for groups of more than fifteen at any one time. For the most part they came in twos and threes, at any hour that fitted in between other engagements, and often brought with them husbands, wives, and friends who wanted to take the test too! This meant that the testing period covered three months--much longer than was originally planned--but the small groups made it possible to be sure of accurate timing and of thorough understanding of the directions, and gave the examiner an opportunity to become personally acquainted with a great many of the subjects. During the testing period, from the middle of December 1942 to the middle of March 1943, telephoning and letter writing were continued until it became obvious that the law of diminishing returns had definitely begun to operate.

Those who broke a number of appointments are listed in Table 3 as "uncooperative." Those who professed interest but couldn't find time to come in, and took the trouble to offer an explanation, are listed as "unable to come." Two girls were unable to come because they could not find anyone to stay with their young babies. Several broke appointments because they decided, very suddenly, to get married. On the other hand, several of the boys home on leave from various branches of the service offered to sacrifice an hour of that leave to take the test. A period of subzero weather discouraged only a few. The impression gained from contact with these young Americans was that they were living amazingly high-tempoed lives.

The Group Who Were Given the Alpha Test

Those tested were a highly select group. They were able to appreciate the significance of the problem under investigation, appeared to enjoy the introductory discussion of the problem, and asked intelligent questions. They approached the test with confidence, obviously expecting to do well, and for the most part appeared to be entirely at ease during the test administration. Quite probably most of the young people who had less pleasant experiences with tests in the past were "unwilling to cooperate" or "unable to come." Some of them admitted that they were intrigued by the name of the test, "Army Alpha," and came because they wanted practice in taking the kind of tests they expected to take in the service. Some hoped to get insight into their abilities and disabilities which might help them to decide on the branch of the service that would be most suitable for them. A number of the boys attending the University of Minnesota or colleges in the Twin Cities were already in the Naval Reserve. The attitudes expressed by these young people toward the war and the part they expected to take in it were interesting. Most of them were eager to get into the service. Many mentioned educational advantages that they prized. Those more realistic than enthusiastic appeared to have accepted with good grace the necessity of interrupting their personal programs and postponing their plans for the future. More than one of the boys felt that he would receive in the service discipline that he needed and desired. A common remark was, "In the service you've got to study--no fooling around and wasting your opportunities there." One was left with the impression that American adolescent boys are given more freedom than they feel capable of using to good advantage--at least at a time of worldwide unrest. Over and over they expressed their willingness to be held to higher standards of conduct and achievement than were set for them, or than they seemed to be able to set for themselves, in civilian life. They looked forward to being put to a real test, and at the same time to being partially relieved of responsibility for their own behavior.

It has been mentioned that the persons actually tested were superior. Table 4, which gives the occupational status of the subjects' fathers, and Table 5, which gives their own educational status (the education of a large proportion was incomplete) bear out this statement. More than half of the fathers of these young people were engaged in professional or managerial work. Only 12 per cent of the males of the general population of Minneapolis (also given in Table 4) are employed in such work. All the subjects had had some high school experience, and 25 were at least one year accelerated at the time of the study. Figures on retardation are not available, since the subjects were not asked to record age at leaving school.

The extremely superior character of the group available for retest is to be expected in a study of this nature made

Table 4--Occupations of Fathers of Subjects Tested on Alpha Test*

	N	%	% Minneapolis†
I. Professional	71	31.42	5.4
II. Semiprofessional and managerial..	54	23.89	6.3
III. Clerical, skilled trades, retail business	49	21.68	37.3
IV. Semiskilled occupations, minor clerical and minor business ..	33	14.60	24.3
V. Slightly skilled trades and occupations requiring little training or ability	8	3.54	14.9
VI. Day laborers of all classes	2	.88	11.8
Not classified‡	9	3.98	0.
Totals	226	99.99	100.0

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*Classification of Employed Males in the United States based on the 1920 Census, Institute of Child Welfare, University of Minnesota.

†The percentage of total male population of Minneapolis was taken from Table 1, p. 17, of Goodenough, Florence L., The Kuhlmann-Binet Tests for Children of Preschool Age: A Critical Study and Evaluation. Minneapolis: University of Minnesota Press, 1928.

‡In 9 cases, 3.98 per cent, the father had been dead for several years or had retired at an early age because of illness. Since all other occupations were present or recent (two professional men had commissions in the service but would be classified as Class I by either occupation), it seemed best to omit these cases from the classification. In many instances mothers also were employed, but no comparable classification for women exists.

Table 5--Subjects Classified According to Age and Years of Education

	Years of Education							
Age	9	10	11	12	13	14	15	16
16½	2	11	7					
17	1	18	9	1				
17½		6	15	5	1			
18		2	8	10	1			
18½			3	27	1			

Table 5--Continued

	Years of Education							
Age	9	10	11	12	13	14	15	16
19			2	15	6	2		
19½				10	15	2	1	
20			1	5	9	5		
20½				1	3	3	2	
21					1	2	3	1
21½				1			4	1
22				1				1

several years after the last contact with the subjects.* As has already been mentioned in *Mental Growth in Children from Two to Fourteen Years* (42), which included a much larger proportion of the whole group, if it had been possible to employ a full-time social worker to keep up contacts, undoubtedly fewer subjects, especially those of less superior intelligence, would have been lost. Under existing circumstances an additional factor favored the elimination of the less intelligent subjects. Those young people nearest the completion of their education, particularly those taking training of a professional nature, were deferred in large numbers during the first year of the war. A very large proportion of the high school boys of average or below average achievement had enlisted and were already in active service, according to the reports of their parents. These were the very boys who would be most eager to leave school and enlist rather than to wait to be drafted. On the other hand, boys of superior achievement were subject to a great deal of pressure from parents and school authorities to continue their education until called. Parents hoped that the boys would more easily get commissions and argued that because of their additional training they would be able to make a greater contribution when they did enter the service. Even in the same family, boys who were nearly through professional courses when the war began were still available while younger brothers had left school to enlist and were receiving some kind of specialized training in the service.

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*Testing for the Mental Growth Study was discontinued in the spring of 1938. Some of the subjects of the present study had not been tested since preschool days--a period of from eleven to sixteen years.

SUBJECTS OF THE TERMINAL STATUS STUDY

Table 6 and Graph A give the distribution of raw Alpha scores for the total group tested. Even though the mean of the group is very high, 146.45, the scores are distributed in a fairly normal manner. The raw scores range from 78 to 203. The standard deviation of the scores is 24.62.

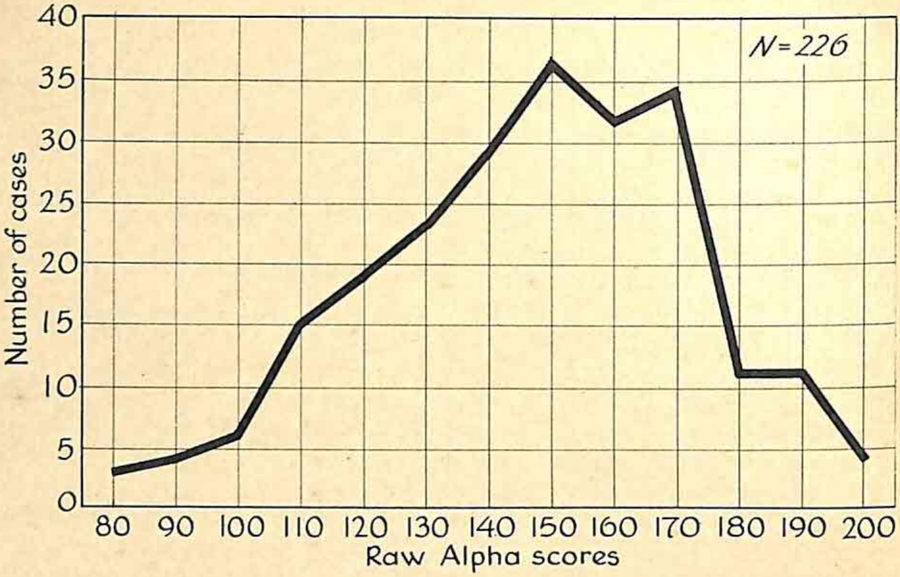
Table 6--Distribution of Alpha Scores of Total Group Tested (N = 226)

Alpha Scores	Number of Cases
75- 84	3
85- 94	4
95- 104	6
105- 114	15
115- 124	19
125- 134	23
135- 144	28
145- 154	36
155- 164	32
165- 174	34
175- 184	11
185- 194	11
195- 204	4
Mean = 146.45	SD = 24.62

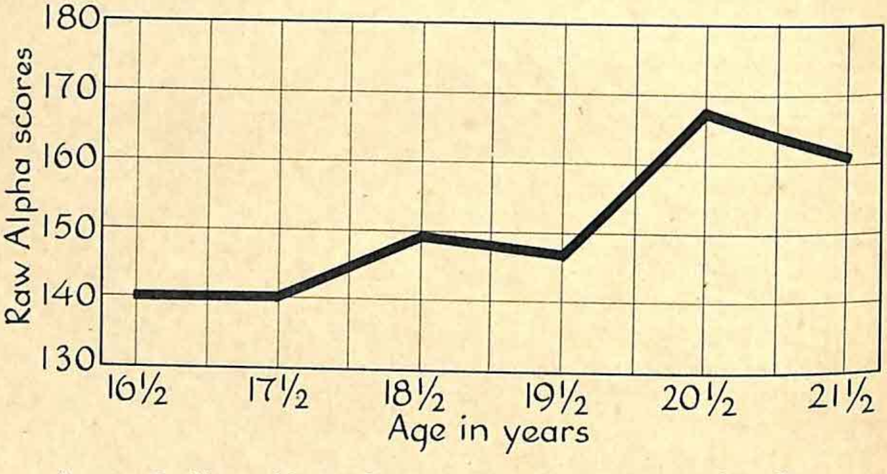
Table 7--Mean Alpha Scores for Separate Age Levels

Age at Alpha	N	Mean Alpha Score
16½	50	140.29
17½	48	140.41
18½	56	148.83
19½	48	146.56
20½	16	166.77
21½	8	160.50

If it can be assumed that this revision of Army Alpha. planned to discriminate among superior individuals, is even a fairly good measure of terminal status, the range of scores is such that differences in predictive value between individual items in tests given at the preschool level should have meaning. Table 7 and Graph B show the mean Alpha scores for subjects grouped according to age at the time of the test. The means rise slightly from 16½



Graph A--Distribution of Alpha Scores of Total Group Tested (Table 6)



Graph B--Mean Alpha Scores for Separate Age Levels (Table 7) to 20, and sharply from 20 to 22. However, the extremely high means of the last two age levels are based on only 16 and 8 subjects respectively. The means of the lower age levels are based on approximately 50 cases each. Apparently terminal status as indicated by the Alpha test has not been reached by 18 years of age, possibly not even by 20--at least for these subjects, most of whom have continued their education during these years.* Another possible explanation of this rise with age is that a selective factor brought more superior children into the study at the later than at the earlier ages of the preschool testing program. If such a factor exists, the nature of it is entirely unknown to the present investigator. However, a selective factor may very well have been present at the time of the Alpha testing. It was probably more inconvenient for the older subjects than for the younger subjects to come in for testing. The older individuals who did come in were cooperative because they appreciated the nature of the problem studied or had research interests of their own. They might be expected to have the higher Alpha scores. On the basis of similar findings for subjects of these ages by other investigators (91, 54, 18) it is reasonable to attribute at least part of the rise in scores to continued mental growth.

Information obtained from the questionnaire on educational, vocational, and recreational interests and experiences, which was filled out by each subject, need not be discussed in detail. But it is interesting to note that even the subjects who made rather poor Alpha scores had had at least some high school education, though in many instances they had not taken an academic course. A number with low Alpha scores reported attending vocational high schools, and several reported having left high school because they lost interest or were not making satisfactory progress. However, it appears that for the next generation the educational status of the parents will not be as good an indication of expected intellectual level as it has been in the past (41, 31). The attempt to educate everyone, which has been one aim of our society in recent years, and the increasingly rigid enforcement of compulsory education laws have decreased the relation between intelligence and the number of years of schooling, a relation that earlier investigations showed to be a useful indication of educational achievement. The names of the schools themselves are confusing and in no way a guide to the intellectual standards students must meet in order to remain in attendance. It seems safe to say that if the war had not intervened most of these young people would have been exposed to as much education of some sort as they would take, although it would be difficult to estimate the quality of that exposure.

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*Thorndike mentions use or disuse of the type of mental skills which intelligence tests measure as a factor affecting data on terminal status. After leaving school, many individuals no longer practice these skills. (91)

Vocational experience, as would be expected, was directly related to age and covered a wide range of occupations. Ninety-five per cent of the boys and 82 per cent of the girls had had some vocational experience if this is defined as work for remuneration and away from home. At one extreme the younger boys reported carrying papers and the girls reported caring for children after school and evenings. At the other extreme was a young man of 21 whose father was dead and who was part owner and manager of a small industrial concern. He was supporting himself, his mother, and five younger brothers and sisters all of whom were in school. One girl of 19 was managing a business of moderate size, employing one of her own sisters, and was the principal wage earner of her family.

The interests, both as to quantity and quality, of those who made the highest Alpha scores were what one would expect of highly gifted young people. Many of them were engaging in truly creative leisure-time activities as well as maintaining excellent records in school and employment. Those with scores of 190 or above included a pair of twin boys, both of whom have since graduated from high school at 17 as valedictorians of a class of over three hundred. One of the girls, 20 years old at the time of the test, had completed three years of work at the University of Minnesota and had just been admitted to the Medical School. Another girl of 21 had completed a four-year course at the university with an exceptionally high record and had begun graduate work in one of the biological sciences. A girl of 19 has since graduated from the university in less than four years with an almost straight A record, has already published some of her stories and poems, and plays the piano exceptionally well. On the questionnaire she listed activities, including many of a purely social nature, that filled half the back of the blank. A boy who had just graduated from high school with a B+ average had engaged in activities as varied as editorial writing and football. The remaining boy in this group, a sophomore in college at 20, with an excellent record, had the typical interests of a highly intelligent but extremely introverted personality. He listed reading as his favorite leisure-time activity, and had no extracurricular activities according to his report. The courses he had enjoyed most in college were philosophy, psychology, advanced language courses, and English literature. He was the only boy of this group who appeared to be even slightly maladjusted. He seemed older than 20 and somewhat cynical and world-weary, though he was pleasant enough and entirely cooperative. One of the girls of this group, whose interests were quite similar to those of the boy just mentioned, also seemed less well adjusted than the others. She had completed several years of college, had left to go to work, was interested in reading and music, and according to her own report was not particularly adept at getting along with people. Since that time she has requested the help of a psychiatrist because of her unhappiness. According to the psychiatrist's report, however, the prognosis is extremely favorable.

Two of the four girls in this group are now married and one is engaged. None of the boys are married, but all are still in school and only one is 21. The early marriage of boys from this social group would be an indication of maladjustment rather than the reverse.

All eight of these subjects with Alpha scores of 190 or above have fathers who are, or have been at one time, on the university staff. The outstandingly good adjustment of this group, most of whom had IQ's of over 150 as children, is impressive to one who has known them over a period of years. This seems particularly noteworthy in the light of the recent discussion by Hollingworth and others concerning the optimal level of intelligence from the point of view of adjustment (87), which stresses the difficulties of adjustment of individuals testing over 150. It should be remembered, however, that this group of young people have all grown up in a university environment in the families of professional people. One can assume that their natural interests were fostered at home, if not always at school, and that they were able to find others like themselves in a university community. It would be interesting to follow these subjects and others who scored only slightly lower on the Alpha for another decade ahd compare their careers with those of exceptionally bright individuals followed by Terman (49) and Hollingworth (48).

The interests, achievements, and personal appearance of subjects who tested below 100 on the Alpha, in contrast to those of the group discussed above, lead one to believe that the differences in score are at least in part indicative of the total life adjustment of those tested.

In nine cases the Alpha scores were below 100. Of these all but one were girls. This is probably due to the greater willingness of the girls to come in and also to the fact already mentioned--that the boys of this ability range were already in the service. Two of the girls had fathers in Class I of the occupational scale, but one was an adopted child. A pair of twins came from Class III, four more girls from Class V, and the one boy from Class VI. This boy had a raw Alpha score of 83. He left high school without graduating because he lost interest and did not get along well with the other students. He expressed regret that he had not transferred to a vocational high school. Although he had had considerable work experience of a semiskilled type, he had found nothing that appealed to him. He appeared apprehensive about his forthcoming induction into the Army and was anxious to be assigned to some clerical work. His highest subscore on the Alpha test was the first one, a simple addition test. He made quite a point of arranging to be tested when he would be alone. When he appeared he seemed ill at ease and had a very unhappy facial expression. A girl in this group, also interviewed alone, had left high school after two years of rather poor work. Since that time she had held a number of jobs in factories and stores. Several of these she had "quit" according to her report. At the time she was interviewed she was working as receptionist in a small night club. What appealed to her most about this work was the hours. She liked to sleep until noon and work late evenings. She explained her frequent change of employment in terms of a girl's needing to "get experience," but she was unable to explain what she meant by experience. If she had any educational or vocational goals it was impossible for the examiner to discover them in a hour and a half's time, though the girl talked very freely. The girl who had been adopted into a professional man's family had not yet completed high school at 19. Her school record was very poor, although she had been tutored frequently, and she had attended several summer sessions to make up work she had failed. Her leisure-time activities were singing in the church choir and sewing. She expected to finish high school in approximately four and a half years after entrance and planned to study music after graduation. Her mother, who called to discuss the test findings, described her as very quiet at home and rather shy with other young people. The twins were attending vocational high school, listed no extracurricular activities, and expressed interest exclusively in domestic affairs, such as making clothes, marketing, and cooking. The other girls of the group followed along similar trends in their interests as reported by themselves. They liked few school subjects other than domestic science, music, and physical education.

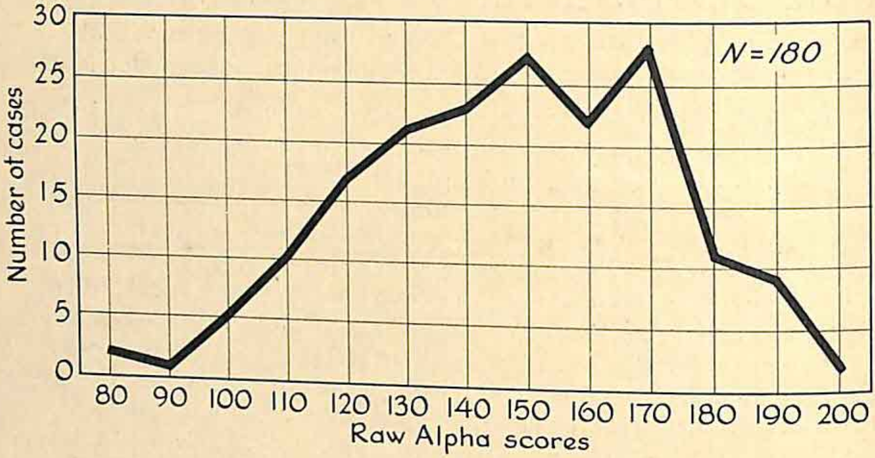
Five of the nine listed no extracurricular activities at all. Their preferred leisure-time activities were going to the movies, dancing, and visiting friends. These are certainly not undesirable pursuits in themselves; neither do they require creative ability, sustained attention, or very much mental effort. These preferences were markedly in contrast to those expressed by the eight subjects with the highest scores, who mentioned such activities as composing music, playing all manner of musical instruments, going to concerts, playing chess, camping, and creative writing, and, in the words of one of them, hope in the future to try "almost anything requiring skill and training that I haven't yet had time for."

The data obtained from the Interests Questionnaire confirm the validity of the Alpha scores as a means of indicating real differences in ability.

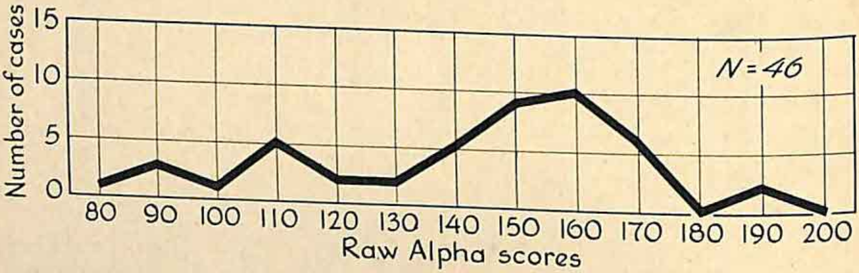
Selection of Validation Groups

Before analysis of the individual items of the preschool tests with reference to terminal status, the records of one fifth of the group who took the Alpha were set aside for use in validation of the findings. This group of 46 subjects was selected by taking every fifth name from an alphabetical list of the subjects' tests. It is referred to as the Alpha Validation Group. Table 8 and Graphs C and D compare the distribution of Alpha scores of the group set aside for validation and the group on which the analysis was made. It will be seen that they do not vary materially as to range of scores and central tendency.

In addition to the primary terminal status group described on the following page, a group of subjects who had had at least one Stanford-Binet (either the 1916 or the 1937 revision) between the ages of 11½ and 15½ years of age were included in the study as a supplementary validation group. In all the comparisons, the latest Binet score for each individual was used. Thus, if a boy was tested at 11½, 13½, and 14½, the test given at 14½ was used. There were 50 cases in this group and they are referred to in the discussion of the results as the Binet Validation Group. Table 9 gives the occupations of the fathers of these subjects. Table 10 gives the distribution of Stanford-Binet scores. The Stanford-Binet



Graph C--Distribution of Alpha Scores of Group Analyzed for the Selection of Items (Table 8)



Graph D--Distribution of Alpha Scores of Validation Group (Table 8) test is the most widely used clinical tool in America and samples a wider range of abilities than any group test. However, it was given at ages somewhat too young for satisfactory use as a measure of terminal status.

Table 8—Comparison of Distributions of Alpha Scores of Analyzed and Validation Groups

Alpha Scores	Analyzed Group (N = 180)	Validation Group (N = 46)
75- 84	2	1
85- 94	1	3
95-104	5	1
105-114	10	5
115-124	17	2
125-134	21	2
135-144	23	5
145-154	27	9
155-164	22	10
165-174	28	6
175-184	11	0
185-194	9	2
195-204	4	0
	Mean = 147.61 SD = 24.62	Mean = 141.89 SD = 26.87

It seemed wisest, therefore, to use the Stanford-Binet group for supplementary study only, keeping in mind that actual terminal status had not been reached when these tests were given. As mentioned above, even the Alpha proved to be related to age for this group. If this study had been made when more of the subjects had attained maturity it would have been more adequate with regard to elimination of the effects of age. However, with a war involving almost the entire young male population as well as a good portion of the young women, it is improbable that a group of subjects large enough to make the study worth doing could have been reached at a later time.

Table 9--Occupations of Fathers of Subjects Tested on Stanford-Binet (N = 50)*

	N	%	% Minneapolis†
I. Professional	16	32	5.4
II. Semiprofessional and managerial..	10	20	6.3
III. Clerical, skilled trades, retail business	8	16	37.3
IV. Semiskilled occupations, minor clerical and minor business..	11	22	24.3
V. Slightly skilled trades and occupations requiring little training or ability	3	6	14.9
VI. Day laborers of all classes	2	4	11.8
Totals	50	100	100.0

*Classification of Employed Males in the United States based on the 1920 Census, Institute of Child Welfare, University of Minnesota.

†The percentage of total male population of Minneapolis was taken from Table 1, p. 17, of Goodenough, Florence L., The Kuhlmann-Binet Tests for Children of Preschool Age: A Critical Study and Evaluation. Minneapolis: University of Minnesota Press, 1928.

Table 10—Distribution of IQ's of Group Tested on Stanford-Binet (N = 50)*

IQ's	Number of Cases
155-164..............................	4
145-154..............................	1
135-144..............................	8
125-134..............................	8
115-124..............................	8
105-114..............................	11
95-104..............................	8
85- 94..............................	1
75- 84..............................	1

Mean = 120.84
SD = 18.87

*The IQ's on the 1916 Stanford-Binet, known to be too low at these ages, were corrected by the method used by Terman, L.M. (85, p. 42).

IV. COLLECTION AND ANALYSIS OF THE DATA

Preliminary Discussion

Before the Alpha test was given, the examiner discussed in nontechnical language the problem to be studied, indicating what some of the practical and theoretical uses of the data would be, why these particular subjects were needed to carry out the investigation, and also expressed gratitude for their cooperation. Including time for answering any questions that were asked, the preliminary discussion took approximately ten minutes.

The Interests Questionnaire

The subjects took an additional twenty minutes to fill out the questionnaire of vocational, educational, and recreational interests and experiences. (See Appendix A.) This was done very informally, and any questions regarding the blank were answered individually. Having the subjects fill out the questionnaire in advance of taking the test served several purposes. It made it possible to adhere rather rigidly to the testing schedule. If anyone was late he could finish the questionnaire after taking the test. In this way it was possible to keep the good will of the subjects, who were very busy and frequently had other engagements following the examining period. Only a few were more than ten minutes late. This procedure also served to establish a mental set--getting the subjects into the swing of using a pencil and answering questions--and rid of any self-consciousness that might interfere with their best performance. Most of the subjects appeared to take the questionnaire seriously and to do their best to give accurate and complete answers. Various individuals took from five to twenty minutes to complete it.

Administration of the Test

The Wells revision of the Army Alpha (96) requires only 21½ minutes of actual testing time. Reading the directions and the pauses between subtests require five or six minutes. Because the time limits for some of the subtests are very short, only 1½ minutes in several cases, it is particularly important that timing should be accurate. To insure accuracy a stop watch was used. The numbers tested at any one time, never more than fifteen, were small enough to enable the examiner to observe that everyone was ready to begin when the signal was given and to make sure that everyone stopped at exactly the same time. Timing was probably more accurate than is usually possible in the administration of a group test to a large number of subjects.

Reporting Test Results to the Subjects

Each subject was sent a report of his test results. The report included his percentile rank in terms of the norms for the general population given on the scoring key and a psychograph of his score on each of the subtests. The graph was prepared by converting the raw score on each subtest into the percentage of the possible score and plotting this percentage on a chart constructed for the purpose. This was done in order to give at least a partial answer to the question so often asked by the subjects concerning which of the tests they did best. Since there are no norms for individual subtests, all that could be done was to show each subject his relative standing on the different parts of the test, i.e., which subtest scores contributed the most to his total score. Each subtest was given a descriptive name that would recall to the subjects the nature of the tasks involved. The psychograph was made in duplicate, and one copy was sent to the subject and the other filed with the subject's record at the institute. The duplicate proved helpful when certain individuals wished to discuss the test results over the phone. The subjects were told at the time of the examination that after receiving the psychograph, they might telephone for a conference regarding their scores. Quite a number availed themselves of this privilege. In line with the permanent policy of the institute no numerical results except percentile rank were given out. What each subject could expect to achieve, assuming that his abilities had been adequately tested, was discussed with him in general terms at the conference. Some felt, with justification, that they were not achieving as much as might be expected on the basis of their test standings, either the standing on the Alpha test or on tests given at earlier ages. Others were trying to push themselves too hard and had become discouraged with the results. Still others lacked confidence in themselves and responded well to reassurance that they did have enough ability to succeed with their plans. They were given guarded but honest answers with respect to these matters; in each instance they were reminded that personality traits, interests, physical energy, special abilities, and work habits, as well as general intellectual status, affect achievement. A number of parents called to discuss the test findings of their children and to give additional information concerning them. All these data were recorded and preserved.

Recording the Data

For each subject who reported for the Alpha test and for each case in the Binet Validation Group a summary sheet was prepared on which was recorded the following information:

1. Identifying data--name, sex, birth date, father's occupation (description and class), present address, and telephone number.
2. Preschool test data--for each of the nine half-year age levels from 1½ through 5½, the test results in terms of IQ or IQE were recorded for four tests (Forms A and B of the Minnesota Preschool Scale, the Merrill-Palmer Performance Tests, and the Kuhlmann-Binet).
3. Terminal status data--besides the primary measure of terminal status, the Wells revision of Army Alpha, both 1916 and 1937 revisions of the Stanford-Binet test results, and years of education completed (from the questionnaire) were recorded. For those who had taken the battery of tests given high school seniors by the University Testing Bureau, the results of the American Council Psychological Examination, 1937 edition, the English Cooperative Test, 1937-38, Form OM, and the high school percentile rank were recorded.* Stanford-Binet test results were recorded in terms of IQ. All other test scores were raw scores; each subtest was recorded separately in addition to the total score.

Item analysis sheets were prepared for recording the passing or failing of each item. This sheet had space at the top for a case number to coincide with that on the summary sheet and for all terminal status data. Each item on each of the preschool tests was given a code number. The item analysis sheets gave the code numbers with space after each item for recording plus (+) for passing and minus (-) for failing each item. A separate item analysis sheet was made out for each subject at each age level of testing. Thus, if John Brown had Form A of the Minnesota test at

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*Through the courtesy of Dr. John Darley, at that time director of the University Testing Bureau, records of our subjects who had been given these tests were made available for study.

3 years of age, Form B and the Merrill-Palmer at 3½, and both Form A and Form B of the Minnesota at 5½, three item analysis sheets were filled out for him. Sex and father's occupational class were also recorded on these forms. Thus all the information required for sorting the data into various subgroups was given on each item analysis sheet.

Several months were required for scoring the Alpha tests and checking each score, making the psychographs and mailing them, conferring with subjects regarding test results, and recording the data on the summary and item analysis sheets. Actual analysis of the data was begun in the fall of 1943. The following section describes the preschool data used and the procedures followed in analyzing the data, in chronological order. Chapters V and VI are concerned with a detailed account of the results of the analysis.

Preschool Data

Scores on items in both forms of the original Minnesota Preschool Scales before the omission of three tests not included in the published scale (44) were analyzed in this study. There were twenty-nine tests originally, made up of 224 items in each scale--a total of 448 items for analysis. Items for which there was differential scoring were counted once for each score. For example, a child was given one point for making a two-block tower, two points for making a three-block tower, etc. Complete descriptions of the test items and procedures for administration and scoring them are given in Appendix B.

Incomplete testing and failure to record each separate item as failed, passed, or omitted, as required in the standard procedure for administration of the Kuhlmann-Binet, made the data from this scale not comparable with the data from the Minnesota Preschool Scale. The Kuhlmann-Binet material was therefore left for a separate study. Not enough of the subjects who reported for the Alpha had been given the Merrill-Palmer Performance Tests to warrant inclusion of the latter in the analysis.

Since the Minnesota Preschool Scale is a point scale, theoretically every child is given every test item regardless of his age. In the published scale rules were given for the omission of a few tests that were obviously beyond the ability range of the younger children. This was done to avoid negativism and to shorten the test for the younger children. Limits of testing (see Appendix B) applying to individual items within tests were also given in the manual (44). However, during the standardization procedure all items of every test (with the exception of those beyond the ability range of the younger children) were given to every child. The tests used in this study are all standardization tests, and therefore represent complete testing on all tests within the child's range of ability. Incomplete tests and tests marked unreliable on the basis of behavior ratings secured at the time of administration have been eliminated.

The group used for selection of the items was comprised of 180 cases. The first step in the analysis of the data was to sort the item analysis sheets into half-year age levels, from 1½ to 5½, the ages at which the Minnesota Preschool Scale was given. Then the numbers and percentages passing and failing each item at each age level were computed. To facilitate study of the age changes, graphs showing the percentages passing at successive age levels were made for each item. These graphs are given in Appendix C.

Choice of Critical Levels for Analysis

Three critical age levels were then selected in the following manner: the age at which closest to 50 per cent of the subjects passed each item was selected as the middle age; then one age level above and one below were selected. At the extremes two levels above or two below the age at which closest to 50 per cent passed were used. Choice of these three levels at which to test the predictive value of each item insured dichotomies of moderate size and permitted validation at the most appropriate ages.

Comparison of Alpha Scores of Subjects Passing and Failing Each Item

The next step in the analysis was to compute the mean Alpha scores (using raw total scores) for those passing and those failing each item at each of the three critical age levels. Then the difference between the two means was found and the direction of the difference was noted. A list was made of all items showing a positive difference in means for each age level. By a positive difference is meant a difference indicating that those passing a given item had a higher mean Alpha score than those failing it. The list of items showing a positive difference between mean Alpha scores of passing and failing groups for Forms A and B of the scale is given in the first column of Tables 11 and 12.

Determining the Relationship of Each Item to the Criterion Score

Because of the small number of cases available at any single age level it was not possible to determine directly the significance of the differences. Therefore biserial correlation was used to find which items were sufficiently related to the criterion scores to warrant selection for a new scale. The biserial correlations and their respective standard errors are given in Tables 11 and 12.* Those items yielding correlations of more than three times their standard errors were listed in three columns for each age level: (1) those over +.70, (2) those between +.50 and +.70, and (3) those between +.30 and +.50. (See Tables 13 and 14.) The items listed only in column 3 were discarded, for they had too little predictive value for use in a new scale. For the most part the same items were found in both column 1 and column 2, and most of their biserial correlations were much more than the conventional three times their standard errors. In a few cases items yielded correlations between +.50 and +.70 only. Inspection shows that the items with high biserial r's group themselves according to the task required. Similar items in both forms of the test tend to have high biserial r's. There are surprisingly few discrepancies between equivalent tests in the two forms. Experience with the test indicates that some items in one form are superior to those in the other. Other discrepancies are probably best explained as sampling errors because of the small number of cases at single age levels. Table 15 lists the selected items from Forms A and B. In spite of the discrepancies mentioned above, where items from one form of the scale yielded high biserial r's and the corresponding items in the other form did not, in making the final choice the best selection of items was obtained by considering together like items in both forms.† The individual items selected will be discussed in detail in Chapter VI.

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*Soper's correction for biserial r when the number of cases is small was used for a number of items and the results compared with those secured by use of the usual formula, $r = \frac{(M_2-M_1)pq}{\sigma z}$ (58). The values were very little changed by this procedure, probably because all the dichotomies involved were moderate. Since the magnitude of the changes was not great enough to affect the selection of items with high predictive value, the correction was discarded and the above formula was used throughout.

†Some tests include a number of items presumably of the same level of difficulty. Others are made up of items of varying degrees of difficulty. In the first case, more than half of the items in a test were required to have high biserial r's to be selected; in the second case, each item was treated as an individual test.

Table 11--Biserial Correlations for Items Showing a Positive Relationship to the Criterion Score
Form A

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
I	POINTING OUT PARTS OF BODY									
	1 eyes	.12 ±.27								
	2 ears		.25 ±.03							
	3 nose									
	4 hands									
	5 chin			.15 ±.14						
II	POINTING OUT OBJECTS IN PICTURES									
	6 man									
	7 chair	.10 ±.33								
	8 apple									
	9 house		.20 ±.10	.06 ±.21						
	10 flower		.90 ±.03	.15 ±.14						
	11 horse									
III	NAMING FAMILIAR OBJECTS									
	12 ball	.04 ±.33	.90 ±.03							
	13 watch		.90 ±.03							
	14 pencil	.23 ±.10								
	15 scissors	.33 ±.29								
	16 cup	.21 ±.15	.03 ±.22	.30 ±.04						
IV	COPYING DRAWINGS									
	17 circle			.34 ±.18	.12 ±.13	.62 ±.08				
	18 triangle						.12 ±.15		.62 ±.07	
	19 diamond							.32 ±.12		
V	IMITATIVE DRAWING									
	20 vertical stroke		13 ±.16	.88 ±.02						
	21 horizontal stroke		.37 ±.18	.88 ±.02						
	22 vertical cross			.67 ±.10						

Table 11--Continued

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
VI	BLOCK BUILDING									
	23 3-cube pyramid			.29 ±.02	.32 ±.11					
	24 6-cube pyramid				.26 ±.12		.70 ±.05			
	25 2-cube tower			.06 ±.20						
	26 3-cube tower	.37 ±.27		.06 ±.20						
	27 4-cube tower	.32 ±.29		.06 ±.20						
	28 5-cube tower	.61 ±.18		.06 ±.20						
	29 6-cube tower	.18 ±.19		.13 ±.17						
VII	RESPONSE TO PICTURES									
	Picture 1									
	30 1 noun									
	31 2 nouns			.63 ±.10						
	32 3 nouns			.60 ±.12						
	33 4 nouns									
	34 6 + nouns							.04 ±.14		
	35 1 verb or prep.						.26 ±.14	.17 ±.14		
	36 2 verbs or prep.									.04 ±.15
	37 3 verbs or prep.							.25 ±.12		
	38 4 verbs or prep.									
	Picture 2									
	39 1 noun		.90 ±.03							
	40 2 nouns		.25 ±.03	.15 ±.14						
	41 3 nouns			.08 ±.23						
	42 4 nouns									
	43 6 + nouns							.29 ±.11		
	44 1 verb or prep.						.05 ±.15	.21 ±.14	.23 ±.12	
	45 2 verbs or prep.						.38 ±.12	.26 ±.13		
	46 3 verbs or prep.									.07 ±.15
	47 4 verbs or prep.							.85 ±.01		
	Picture 3									
	48 1 noun		.90 ±.03	.15 ±.14						
	49 2 nouns	.16 ±.22		.63 ±.10						
	50 3 nouns		.14 ±.16							
	51 4 nouns					.21 ±.16				
	52 6 + nouns									
	53 1 verb or prep.									.04 ±.15
	54 2 verbs or prep.							.27 ±.14		
	55 3 verbs or prep.									
	56 4 verbs or prep.									

Table 11--Continued

Test No.	Item	Ages								
		1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
VIII	KNOX CUBE IMITATION									
	57 1234			.62 ±.11		.76 ±.05				
	58 12343					.16 ±.16	.30 ±.14	.25 ±.14		
	59 12342					.02 ±.17	.45 ±.12	.26 ±.15		
	60 1324							.41 ±.12	.31 ±.12	.44 ±.11
	61 1432							.36 ±.12	.41 ±.11	.43 ±.11
	62 1423								.55 ±.09	.50 ±.10
	63 13243								.70 ±.04	.26 ±.13
	64 14324								.52 ±.08	.42 ±.11
	65 13124								.26 ±.11	
IX	OBEYING SIMPLE COMMANDS									
	66 Throwing ball									
	67 Doll on chair	.37 ±.27	.13 ±.60							
	68 Giving doll drink									
	69 Two commands									
	70 Three commands					.49 ±.10				
X	COMPREHENSION									
	71 hungry			.15 ±.14	.35 ±.11					
	72 sleepy				.23 ±.12					
	73 fire					.49 ±.11	.26 ±.14			
XI	DISCRIMINATION OF FORMS									
	74 circle	.58 ±.18		.30 ±.04						
	75 rectangle				.29 ±.11					
	76 #3									
	77 #4									
	78 #5									
	79 #6									
	80 #7			.01 ±.22		.67 ±.06				
	81 #8			.18 ±.13		.65 ±.07				
	82 #9			.48 ±.16		.56 ±.10				
	83 #10				.35 ±.11	.56 ±.10	.64 ±.07			

Table 11—Continued

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
XII	NAMING OBJECTS FROM MEMORY									
84	doll									
85	pencil				.17 ±.13	.15 ±.15				
86	penny									
87	horse				.19 ±.13	.32 ±.13				
88	cup					.58 ±.10				
89	shoe					.07 ±.16				
90	glove								.14 ±.14	.10 ±.15
91	fork									
92	table							.09 ±.14		
XIII	AESTHETIC COMPARISON									
93	Picture 1		.54 ±.12		.14 ±.13					
94	Picture 2									
95	Picture 3									
IV	RECOGNITION OF FORMS									
96	#1					.44 ±.13	.09 ±.15			
97	#2								.10 ±.14	
98	#3				.12 ±.14	.39 ±.14				
99	#4							.34 ±.13		
100	#5					.60 ±.09				
101	#6						.16 ±.15			
102	#7									.32 ±.13
103	#8						.04 ±.15		.04 ±.14	
XV	COLORS									
104	red			.62 ±.11		.35 ±.13				
105	blue				.29 ±.12	.53 ±.10				
106	pink				.73 ±.12	.96 ±.04				
107	white				.29 ±.12	.31 ±.14				
108	brown					.53 ±.11	.46 ±.11			

Table 11--Continued

Test No.	Item	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
		Ages								
XVI	TRACING A FORM									
	109 circle #1			.47 ±.14	.05 ±.13					
	110 circle #2			.55 ±.13	.15 ±.13	.58 ±.09				
	111 circle #3				.34 ±.12	.34 ±.14				
	112 circle #4					.50 ±.11		.14 ±.14.		
	113 square #1			.25 ±.05	.05 ±.14	.24 ±.15				
	114 square #2					.26 ±.15				
	115 square #3				.15 ±.13	.53 ±.11	.23 ±.14			
	116 square #4						.43 ±.12	.44 ±.11		
	117 irregular #1				.29 ±.12	.35 ±.14				
	118 irregular #2				.18 ±.13	.50 ±.12				
	119 irregular #3					.66 ±.07		.33 ±.13		
	120 irregular #4							.44 ±.11		.22 ±.14
XVII	PICTURE PUZZLES: RECTANGULAR									
	121 Picture 1					.93 ±.04				
	122 Picture 2					.12 ±.11				
	123 Picture 3 #1					.56 ±.10	.47 ±.11			
	124 Picture 3 #2					.66 ±.08	.36 ±.13	.13 ±.15		
	125 Picture 3 #3							.31 ±.13		.27 ±.13
	126 Picture 4 #1						.77 ±.04	.44 ±.11	.21 ±.12	
	127 Picture 4 #2						.71 ±.06	.35 ±.13	.32 ±.12	
	128 Picture 4 #3							.35 ±.13	.26 ±.13	.68 ±.05
	129 Picture 4 #4							35 ±.13	.25 ±.13	
XVIII	INCOMPLETE PICTURES									
	130 Picture 1 #1		.07 ±.19							
	131 Picture 1 #2	.23 ±.10	.33 ±.17	.63 ±.10						
	132 Picture 1 #3					46 ±.12				
	133 Picture 1 #4							.03 ±.15		
	134 Picture 1 #5							.07 ±.15		
	135 Picture 2 #1		.59 ±.11							
	136 Picture 2 #2		.09 ±.21							
	137 Picture 2 #3		.09 ±.21							
	138 Picture 2 #4									
	139 Picture 2 #5									
	140 Picture 3 #1	.34 ±.28	.05 ±.21	.15 ±.14						
	141 Picture 3 #2		.05 ±.22							
	142 Picture 3 #3			.15 ±.16						
	143 Picture 3 #4									

Table 11--Continued

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
XIX	DIGIT SPAN									
	144 1 digit		.90 ±.03							
	145 2 digits	.97 ±.10	.70 ±.08							
	146 3 digits			.75 ±.07						
	147 4 digits					.53 ±.11				
	148 5 digits							.36 ±.12	.24 ±.13	.48 ±.10
	149 6 digits							.07 ±.14	.30 ±.11	.27 ±.13
	150 7 digits									.29 ±.11
XX	PICTURE PUZZLES: DIAGONAL									
	151 Picture 1			.10 ±.22						
	152 Picture 2			.35 ±.18						
	153 Picture 3							.33 ±.13	.27 ±.13	.51 ±.09
	154 Picture 4 #1						.06 ±.15	.86 ±.01	.37 ±.11	
	155 Picture 4 #2						.81 ±.02	.58 ±.09	.13 ±.13	
	156 Picture 4 #3							.58 ±.09	.05 ±.14	.35 ±.12
	157 Picture 4 #4							.52 ±.10		.14 ±.14
	158 Picture 4 #5							.58 ±.08		.02 ±.15
	159 Picture 4 #6							.68 ±.05		.29 ±.13
XXI	DEFINITIONS									
	160 fork				.47 ±.10	.40 ±.13				
	161 horse				.11 ±.14	.70 ±.06				
	162 balloon				.12 ±.12	.19 ±.16	.27 ±.14			
	163 soldier				.06 ±.14	.22 ±.16				
	164 tiger					.05 ±.17				
XXII	PAPER FOLDING									
	165 a				.39 ±.11	.36 ±.14				
	166 b						.32 ±.13			
	167 c								.37 ±.10	
XXIII	ABSURDITIES									
	168 #1							.66 ±.07	.37 ±.11	.57 ±.08
	169 #2						.27 ±.14	.56 ±.09	.18 ±.13	
	170 #3							.50 ±.10	.09 ±.14	
	171 #4						.49 ±.10	.47 ±.11	.26 ±.13	
	172 #5							.67 ±.06	.66 ±.06	.38 ±.12
	173 #6							.61 ±.08	.13 ±.14	.51 ±.10
	174 #7								.46 ±.08	.17 ±.12

Table 11--Continued

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
XXIV	MUTILATED PICTURES									
	175 Picture 1		.13 ±.17	.22 ±.07						
	176 Picture 2			.44 ±.17	.08 ±.14	.47 ±.12				
	177 Picture 3			.45 ±.15						
	178 Picture 4							.03 ±.14		
	179 Picture 5								.02 ±.14	.41 ±.10
XXV	VOCABULARY									
	180 puddle					.52 ±.11	.34 ±.12			
	181 envelope				.22 ±.13	.24 ±.05				
	182 gown						.40 ±.12	.15 ±.15		
	183 tap							.05 ±.15	.35 ±.12	.04 ±.14
	184 scorch							.19 ±.13	.34 ±.11	.52 ±.10
	185 rule						.34 ±.14	.17 ±.14		
	186 eyelash				.29 ±.12	.60 ±.09				
	187 health								.28 ±.12	.58 ±.09
	188 copper							.23 ±.13		.40 ±.12
	189 pork							.17 ±.14	.04 ±.14	
	190 curse								.15 ±.12	.51 ±.08
	191 outward								.25 ±.11	
	192 southern							.40 ±.10	.62 ±.05	.60 ±.06
	193 lecture							.62 ±.05	.50 ±.08	
	194 dungeon								.06 ±.12	.63 ±.06
	195 insure							.40 ±.10	.50 ±.08	
	196 nerve									.24 ±.13
	197 brunette									
	198 hysterics									
	199 Mars								.50 ±.07	
	200 skill									
	201 ramble									
	202 civil									
	203 juggler									
	204 regard									

Table 11--Continued

Test No.	Item	Ages								
		1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
XXVI	COMPREHENSION OF DIRECTIONS									
205	a								.23 ±.12	.68 ±.06
206	b								.34 ±.12	.50 ±.10
207	c							.32 ±.12	.04 ±.14	.71 ±.05
208	d							.45 ±.09	.26 ±.13	.79 ±.03
XXVII	GIVING WORD OPPOSITES									
209	cold						.27 ±.14	.27 ±.14	.21 ±.13	
210	bad							.48 ±.11	.01 ±.14	
211	short							.66 ±.07	.09 ±.14	.92 ±.01
212	thick							.15 ±.14	.53 ±.09	.41 ±.12
213	dry						.18 ±.14	.26 ±.14	.48 ±.10	
214	pretty							.15 ±.13		
215	sweet							.39 ±.10	.14 ±.12	.46 ±.11
216	dark						.28 ±.14	.20 ±.14		
217	sick							.17 ±.14	.11 ±.14	.65 ±.07
218	asleep							.23 ±.14	.18 ±.13	.73 ±.05
XXVIII	IMITATING POSITION OF CLOCK HANDS									
219	8:10									
220	1:50									
221	12:00						.30 ±.13			
222	1:10						.17 ±.15	.59 ±.08	.20 ±.13	
XXIX	SPEECH									
223	words						.84 ±.00			
224	sentences			.42 ±.17						

Table 12--Biserial Correlations for Items Showing a Positive Relationship to the Criterion Score
Form B

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
I	POINTING OUT PARTS OF BODY									
	1 mouth									
	2 arms		1.11 ±.15							
	3 hair									
	4 feet									
	5 knees	.56 ±.14		.67 ±.07						
II	POINTING OUT OBJECTS IN PICTURES									
	6 dog									
	7 doll									
	8 shoe			.42 ±.12						
	9 tree	1.01 ±.10	.19 ±.22	.05 ±.17						
	10 bird	.08 ±.25	1.11 ±.15							
	11 cup	.13 ±.25								
III	NAMING FAMILIAR OBJECTS									
	12 doll	.36 ±.21								
	13 key	.99 ±.07	.14 ±.22	.82 ±.00						
	14 penny	1.01 ±.10								
	15 book	.12 ±.25								
	16 spoon	.50 ±.18	.19 ±.19							
IV	COPYING DRAWINGS									
	17 cross			.57 ±.10	.16 ±.16	.57 ±.10				
	18 square						.48 ±.18	43 ±.11		
	19 star							.34 ±.12		.09 ±.17
V	IMITATIVE DRAWING									
	20 vertical scribble									
	21 horizontal scribble			.34 ±.16	.10 ±.15					
	22 right angle						.58 ±.12			

Table 12--Continued

Test No.	Item	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
		Ages								
VI	BLOCK BUILDING									
23	3-cube chair		.35 ±.19	.35 ±.15	.75 ±.04					
24	6-cube stairs					.58 ±.10		.66 ±.06		
25	2-cube tower	.63 ±.11		.82 ±.00						
26	3-cube tower	.04 ±.25		.82 ±.00						
27	4-cube tower	.04 ±.25		.82 ±.00						
28	5-cube tower	.45 ±.19		.82 ±.00						
29	6-cube tower	.21 ±.24	.45 ±.15	.82 ±.00						
VII	RESPONSE TO PICTURES									
	Picture 1									
30	1 noun			.48 ±.11						
31	2 nouns			.24 ±.16						
32	3 nouns			.17 ±.18						
33	4 nouns				.14 ±.16	.38 ±.14	.40 ±.20			
34	6 + nouns						.22 ±.22	.46 ±.11		
35	1 verb or prep.			.56 ±.10		.04 ±.17				
36	2 verbs or prep.							.35 ±.13		.42 ±.11
37	3 verbs or prep.							.37 ±.12		.42 ±.13
38	4 verbs or prep.								.25 ±.14	.23 ±.15
	Picture 2									
39	1 noun			.48 ±.11						
40	2 nouns	.23 ±.24								
41	3 nouns		.17 ±.22	.41 ±.14						
42	4 nouns				.15 ±.16	.58 ±.10	.31 ±.21			
43	6 + nouns								.07 ±.17	.05 ±.17
44	1 verb or prep.				.10 ±.17		.58 ±.12			
45	2 verbs or prep.							.30 ±.14		.46 ±.11
46	3 verbs or prep.								.02 ±.17	.34 ±.14
47	4 verbs or prep.								.02 ±.16	.55 ±.10

Table 12--Continued

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
	Picture 3									
48	1 noun									
49	2 nouns		.80 ±.03	.16 ±.17						
50	3 nouns		.30 ±.20	.32 ±.16						
51	4 nouns				.21 ±.16	.80 ±.03				
52	6 + nouns							.22 ±.14	.58 ±.10	
53	1 verb or prep.						.54 ±.16	.06 ±.15		
54	2 verbs or prep.							.22 ±.14		.19 ±.16
55	3 verbs or prep.							.27 ±.13		.12 ±.17
56	4 verbs or prep.							.35 ±.12		.50 ±.11
VIII	KNOX CUBE IMITATION									
57	4321				.50 ±.11		.58 ±.12			
58	43212						.67 ±.10			
59	43213					.48 ±.12	.68 ±.10	.38 ±.12		
60	4231							.76 ±.04	.04 ±.17	.38 ±.14
61	4123								.03 ±.17	.42 ±.13
62	4132							.20 ±.13		.70 ±.06
63	42312							.43 ±.10		.33 ±.14
64	41231							.78 ±.02	.44 ±.15	.67 ±.07
65	42431							.78 ±.02	.09 ±.14	.34 ±.14
IX	OBEYING SIMPLE COMMANDS									
66	throwing ball									
67	ball on table									
68	wiping doll's nose									
69	2 commands									
70	3 commands									
X	COMPREHENSION									
71	cold			.17 ±.18	.06 ±.16					
72	thirsty					.38 ±.14				
73	trolley car					.34 ±.15	.25 ±.23			

Table 12--Continued

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
XI	DISCRIMINATION OF FORMS									
74	ellipse		.24 ±.21	.17 ±.18						
75	square		.50 ±.14	.04 ±.18	.18 ±.15					
76	#3									
77	#4									
78	#5				.18 ±.16					
79	#6			.32 ±.15	.18 ±.16	.47 ±.11				
80	#7			.32 ±.15	.18 ±.16	.47 ±.11				
81	#8			.32 ±.15	.32 ±.15	.66 ±.06				
82	#9			.32 ±.15	.25 ±.16	.19 ±.16				
83	#10					.58 ±.10	.71 ±.09	.43 ±.11		
XII	NAMING OBJECTS FROM MEMORY									
84	ball			.49 ±.13						
85	key			.34 ±.16	.49 ±.11					
86	pencil			.28 ±.17						
87	tree			.15 ±.17	.56 ±.01	.33 ±.15				
88	bird			.28 ±.16	.22 ±.16					
89	man			.34 ±.15		.45 ±.12				
90	scissors					.19 ±.15	.45 ±.19	.10 ±.15		
91	basket							.17 ±.15	.14 ±.16	.37 ±.14
92	cat					.08 ±.16	.23 ±.23	.17 ±.15		
XIII	AESTHETIC COMPARISON									
93	#1				.19 ±.16					
94	#2					.11 ±.16				
95	#3					.28 ±.16	.54 ±.16	.37 ±.12		

Table 12--Continued

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
XIV	RECOGNITION OF FORMS									
96	#1				.43 ±.13	.69 ±.07				
97	#2				.41 ±.13	.30 ±.15	.51 ±.16			
98	#3						.34 ±.21	.50 ±.10	.19 ±.16	
99	#4								.32 ±.14	.13 ±.16
100	#5					36 ±.14		.49 ±.08		
101	#6					30 ±.15	.38 ±.21	.35 ±.13		
102	#7									
103	#8					.41 ±.14		.21 ±.14		
XV	COLORS									
104	yellow					.68 ±.07				
105	orange								.08 ±.17	.04 ±.16
106	green			.79 ±.03	.22 ±.16	.83 ±.02				
107	black			.53 ±.11		.70 ±.05				
108	purple				.14 ±.16	.72 ±.06	.81 ±.03			
XVI	TRACING A FORM									
109	ellipse #1			.87 ±.00		.52 ±.10				
110	ellipse #2			.77 ±.03	.32 ±.15	.33 ±.14				
111	ellipse #3			1.00 ±.10	.36 ±.14	.43 ±.12				
112	ellipse #4					.72 ±.06	.71 ±.09			
113	diamond #1			.57 ±.10	.13 ±.16	.84 ±.01				
114	diamond #2			.65 ±.06	.20 ±.16	.52 ±.10				
115	diamond #3				.28 ±.15	.54 ±.10				
116	diamond #4					.27 ±.16				
117	cross #1			.30 ±.14	.52 ±.11	.65 ±.08				
118	cross #2				.52 ±.11	.49 ±.12	.71 ±.07			
119	cross #3				.37 ±.14	.51 ±.12	.81 ±.03			
120	cross #4						.18 ±.24	.29 ±.14	.42 ±.13	

Table 12--Continued

Test No.	Item	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
XVII	PICTURE PUZZLES: RECTANGULAR									
121	picture 1			.45 ±.12	.41 ±.13	.66 ±.06				
122	picture 2			.09 ±.18	1.05 ±.07					
123	picture 3 #1							.40 ±.12	.17 ±.16	
124	picture 3 #2							.63 ±.07	.26 ±.15	.36 ±.14
125	picture 3 #3							.63 ±.07	.26 ±.15	.26 ±.15
126	picture 4 #1						.22 ±.23	.52 ±.10	.55 ±.10	
127	picture 4 #2						.22 ±.23	.53 ±.10	.28 ±.15	
128	picture 4 #3							.54 ±.09	.35 ±.14	.42 ±.12
129	picture 4 #4							.48 ±.10	.48 ±.12	.30 ±.14
XVIII	INCOMPLETE PICTURES									
130	picture 1 #1			.82 ±.00						
131	picture 1 #2	.13 ±.23		.24 ±.16						
132	picture 1 #3	1.00 ±.10		.17 ±.18						
133	picture 1 #4					.18 ±.16	.52 ±.16			
134	picture 1 #5					.45 ±.13	.07 ±.24			
135	picture 2 #1			.56 ±.10						
136	picture 2 #2	.13 ±.23.		.82 ±.00						
137	picture 2 #3									
138	picture 2 #4			.11 ±.18						
139	picture 2 #5							.24 ±.14		
140	picture 3 #1	1.01 ±.10	.13 ±.22	.77 ±.03						
141	picture 3 #2	1.01 ±.10		.75 ±.05						
142	picture 3 #3								.09 ±.16	
143	picture 3 #4					.15 ±.17	.99 ±.07			
XIX	DIGIT SPAN									
144	1 digit	.12 ±.25	.20 ±.21							
145	2 digits	.52 ±.16	.18 ±.22	.33 ±.15						
146	3 digits		.32 ±.20	.79 ±.04						
147	4 digits			.71 ±.04		.69 ±.06				
148	5 digits						.11 ±.24	.22 ±.14	.29 ±.15	
149	6 digits							.49 ±.08	.31 ±.12	66 ±.07
150	7 digits							.49 ±.08		.28 ±.13

Table 12--Continued

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
XX	PICTURE PUZZLES: DIAGONAL									
	151 picture 1				.39 ±.14					
	152 picture 2			.33 ±.15	.09 ±.17					
	153 picture 3							.32 ±.13	.38 ±.14	.87 ±.00
	154 picture 4 #1						.69 ±.10	.18 ±.15		
	155 picture 4 #2							.17 ±.14		.16 ±.16
	156 picture 4 #3							.12 ±.14		.23 ±.16
	157 picture 4 #4							.12 ±.14		.26 ±.15
	158 picture 4 #5							.07 ±.13	.07 ±.17	.27 ±.15
	159 picture 4 #6							.14 ±.12	.07 ±.17	.27 ±.15
XXI	DEFINITIONS									
	160 knife			.72 ±.06	.37 ±.14	.69 ±.06				
	161 chicken			1.01 ±.07	.46 ±.12	.47 ±.12				
	162 automobile			.12 ±.17	.62 ±.08	.88 ±.01				
	163 barber				.54 ±.11	1.05 ±.08				
	164 lion							.33 ±.13	.35 ±.14	
XXII	PAPER FOLDING									
	165 a					.36 ±.14				
	166 b							.29 ±.14		
	167 c							.56 ±.09	.12 ±.17	.09 ±.17
XXIII	ABSURDITIES									
	168 #1							.55 ±.09	.08 ±.17	.49 ±.11
	169 #2							.42 ±.12	.07 ±.17	.66 ±.07
	170 #3							.37 ±.12		.60 ±.07
	171 #4							.50 ±.10		.35 ±.14
	172 #5							.48 ±.10	.21 ±.16	.21 ±.16
	173 #6							.75 ±.02	.37 ±.16	.19 ±.16
	174 #7							.51 ±.09	.24 ±.13	.70 ±.06

Table 12--Continued

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
XXIV	MUTILATED PICTURES									
175	#1			.53 ±.11	.48 ±.09	.82 ±.02				
176	#2			.45 ±.14	.30 ±.15	.03 ±.16				
177	#3		.24 ±.20	.85 ±.01						
178	#4		.50 ±.14	.23 ±.17	.10 ±.16					
179	#5							.59 ±.08	.33 ±.15	.97 ±.04
XXV	VOCABULARY									
180	orange				.10 ±.17	.49 ±.11				
181	bonfire				.34 ±.14	.41 ±.14	.81 ±.03			
182	straw				.28 ±.15	.72 ±.06	.81 ±.03			
183	roar						.69 ±.10	.18 ±.14	.19 ±.16	
184	haste					.76 ±.02				
185	afloat					.61 ±.09	.68 ±.10	.43 ±.12		
186	plumbing							.25 ±.13	.49 ±.12	.24 ±.15
187	impolite							.30 ±.12	.49 ±.12	.61 ±.09
188	noticeable								.47 ±.10	
189	guitar							.84 ±.01	.47 ±.10	.40 ±.12
190	mellow									
191	muzzle								.11 ±.16	.71 ±.04
192	majesty									.36 ±.12
193	treasury									.50 ±.10
194	misuse									
195	quake									.21 ±.13
196	reception									
197	apish									
198	snip									.37 ±.12
199	peculiarity									
200	crunch									1.00 ±.07
201	forfeit									
202	sportive									
203	shrewd									
204	repose									

Table 12--Continued

Test No.	Item	Ages 1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2
XXVI	COMPREHENSION OF DIRECTIONS									
205	a							.39 ±.11	.46 ±.12	.56 ±.10
206	b							.20 ±.13	.47 ±.14	.60 ±.09
207	c							.42 ±.11	.67 ±.09	.27 ±.15
208	d							.72 ±.04	.21 ±.15	.86 ±.01
XXVII	GIVING WORD OPPOSITES									
209	little					.64 ±.08	.55 ±.15	.44 ±.11		
210	up						.18 ±.24	.33 ±.13	.09 ±.17	
211	slow						.43 ±.19	.23 ±.14	.76 ±.06	
212	soft							.04 ±.15	.60 ±.09	.42 ±.12
213	in					.42 ±.13	.19 ±.24	.61 ±.08		
214	dirty					.74 ±.05	.63 ±.12			
215	heavy								.47 ±.12	.47 ±.12
216	rough							.33 ±.12		.20 ±.15
217	dead								.28 ±.14	.55 ±.10
218	open				.66 ±.07	.11 ±.17	.41 ±.20			
XXVIII	IMITATING POSITION OF CLOCK HANDS									
219	10:20					.11 ±.17	.41 ±.20	.44 ±.11		
220	4:40							.33 ±.12		
221	6:30				.03 ±.16					
222	10:45							.36 ±.12	.32 ±.15	.17 ±.16
XXIX	SPEECH									
223	words									
224	sentences	.34 ±.20	.50 ±.15	.55 ±.10						

Table 13--Items with Biserial r's Three or More Times Their Standard Errors

FORM A

		+.70 and Over		+.50 to +.70		+.30 to +.50	
Age	N	Item No.	r	Item No.	r	Item No.	r
1½	10	145	.97±.10	28	.61±.18		
				74	.58±.18		
2	13	10	.90±.03	135	.59±.11		
		12	.90±.03	93	.54±.12		
		13	.90±.03				
		39	.90±.03				
		41	.90±.03				
		48	.90±.03				
		144	.90±.03				
		145	.70±.03				
2½	12	20	.88±.02	22	.67±.10	16	.30±.04
		21	.88±.02	31	.63±.10	109	.47±.14
		146	.75±.07	32	.60±.12	177	.45±.15
				49	.63±.10		
				57	.62±.11		
				104	.62±.11		
				110	.55±.13		
3	33					71	.35±.11
						83	.35±.11
						160	.47±.10
						165	.39±.11
3½	22	57	.76±.05	17	.62±.08		
		106	.96±.04	80	.67±.06		
		121	.93±.04	81	.65±.07		
		161	.70±.06	82	.56±.10		
				83	.56±.10		
				88	.58±.10		
				100	.60±.09		
				105	.53±.10		
				108	.53±.11		
				110	.58±.09		
				112	.50±.11		
				115	.53±.11		
				118	.50±.12		
				119	.66±.07		
				123	.56+.10		

Table 13--Continued

		+.70 and Over		+.50 to +.70		+.30 to +.50	
Age	N	Item No.	r	Item No.	r	Item No.	r
				124	.66±.08		
				147	.53±.11		
				180	.52±.11		
				186	.60±.09		
4	26	24	.70±.05	83	.64±.07	45	.38±.12
		126	.76±.04			59	.45±.12
		127	.71±.06			108	.46±.11
		155	.81±.02			116	.43±.12
		223	.84±.00			123	.48±.11
						171	.49±.10
						182	.40±.12
4½	28	47	.85±.01	155	.58±.09	60	.41±.12
		154	.86±.01	156	.58±.09	61	.36±.12
				157	.52±.02	116	.44±.11
				158	.58±.08	120	.44±.11
				159	.68±.05	126	.44±.11
				168	.66±.07	148	.36±.12
				169	.56±.09	171	.47±.11
				170	.50±.10	192	.40±.10
				172	.67±.06	195	.40±.10
				173	.61±.08	207	.45±.09
				193	.62±.05	210	.48±.11
				211	.66±.07	215	.39±.10
				222	.59±.08		
5	32	63	.70±.04	18	.62±.02	19	.36±.12
				62	.55±.09	61	.41±.11
				64	.52±.08	154	.37±.11
				172	.63±.06	167	.37±.10
				193	.62±.05	168	.37±.11
				195	.50±.08	174	.46±.08
				199	.50±.07	184	.34±.11
				212	.53±.09	213	.48±.10
5½	28	193	.73±.04	62	.50±.10	19	.45±.11
		207	.71±.05	128	.68±.10	60	.44±.11

Table 13--Continued

Age	N	+.70 and Over		+.50 to +.70		+.30 to +.50	
		Item No.	r	Item No.	r	Item No.	r
		208	.79±.03	153	.51±.09	61	.43±.11
		211	.92±.01	168	.57±.08	64	.42±.11
		218	.73±.05	171	.60±.08	148	.48±.10
				173	.51±.10	172	.38±.12
				184	.51±.10	179	.41±.10
				187	.58±.09	188	.40±.12
				190	.51±.08	212	.41±.12
				192	.60±.06	215	.46±.11
				194	.63±.06		
				205	.68±.06		
				206	.50±.10		
				217	.65±.07		

Table 14--Items with Biserial r's Three or More Times Their Standard Errors

FORM B

Age	N	+.70 and Over		+.50 to +.70		+.30 to +.50	
		Item No.	r	Item No.	r	Item No.	r
1½	9	9	1.01±.10	229	.56±.14		
		13	.99±.07	249	.63±.11		
		14	1.01±.10	369	.52±.16		
		132	1.01±.10				
		140	1.01±.10				
		141	1.01±.10				
2	12	2	1.11±.15	299	.50±.14	253	.45±.15
		10	1.11±.15	402	.50±.14		
		49	.80±.03	448	.50±.15		
2½	18	13	.82±.00	229	.67±.07	232	.42±.12
		25	.82±.00	241	.56±.10	254	.48±.11
		26	.82±.00	259	.56±.10	263	.48±.11
		106	.79±.03	331	.53±.11	308	.49±.13
		109	.87±.00	337	.57±.10	345	.45±.12
		110	.77±.03	338	.65±.06	400	.45±.14
		111	1.00±.10	356	.55±.11		

Table 14--Continued

Age	N	+.70 and Over Item No.	r	+.50 to +.70 Item No.	r	+.30 to +.50 Item No.	r
		130	.82±.00	399	.53±.11		
		131	.74±.04	448	.55±.10		
		135	.82±.00				
		136	.82± 00				
		140	.77±.03				
		141	.75±.05				
		146	.79±.04				
		147	.71±.04				
		160	.72±.06				
		161	1.01±.07				
		77	.85±.01				
3	22	23	.75±.04	281	.50±.11	309	.49±.11
		122	1.05±.07	311	.56±.01	320	.43±.13
				341	.52±.11	321	.41±.13
				342	.52±.11	345	.41±.13
				386	.62±.08	385	.46±.12
				387	.54±.11	399	.48±.09
				442	.66±.07		
3½	21	51	.80±.03	241	.57±.10	283	.48±.12
		106	.83±.02	248	.58±.10	303	.47±.11
		107	.70±.05	266	.58±.10	304	.47±.11
		108	.72±.06	305	.66±.06	313	.45±.12
		112	.72±.06	307	.58±.10	335	.43±.12
		113	.84±.01	320	.69±.07	342	.49±.12
		162	.88±.01	328	.68±.07	358	.45±.13
		163	1.05±.08	333	.52±.10	371	.48±.12
		164	.70±.07	338	.52±.10	385	.47±.12
		175	.82±.02	339	.54±.10	404	.49±.11
		182	.72±.06	341	.65±.08	437	.42±.13
		184	.76±.02	343	.51±.12		
		214	.74±.05	345	.66±.06		
		218	.77±.04	409	.61±.09		
				433	.64±.08		
4	10	83	.71±09	246	.58±.12		
		108	.81±.03	268	.58±.12		
		112	.71±.09	277	.54±.16		

Table 14--Continued

Age	N	+.70 and Over		+.50 to +.70		+.30 to +.50	
		Item No.	r	Item No.	r	Item No.	r
		118	.71±.07	281	.58±.12		
		119	.81±.03	282	.67±.10		
		143	.99±.07	283	.68±.10		
		181	.81±.03	319	.54±.16		
		182	.81±.03	321	.51±.16		
				357	.52±.16		
				378	.69±.10		
				407	.69±.10		
				409	.68±.10		
				433	.55±.15		
				438	.63±.12		
4½	27	60	.76±.04	248	.66±.06	242	.43±.11
		64	.78±.02	322	.50±.10	243	.34±.12
		65	.78±.02	324	.59±.08	258	.46±.11
		173	.75±.02	348	.63±.07	261	.37±.12
		189	.84±.00	349	.63±.02	283	.38±.12
		208	.72±.04	350	.52±.10	287	.43±.10
				351	.53±.10	307	.43±.11
				352	.54±.09	319	.37±.12
				391	.56±.09	347	.40±.12
				392	.55±.09	353	.48±.10
				395	.50±.10	372	.49±.08
				398	.51±.09	373	.49±.08
				403	.59±.08	393	.42±.12
				437	.61±.08	394	.37±.12
						396	.48±.10
						409	.43±.12
						429	.39±.11
						431	.42±.11
						433	.41±.12
						443	.44±.11
						444	.48±.10
						446	.36±.12
5	22	211	.76±.06	276	.58±.10	344	.42±.13
				350	.55±.10	353	.48±.12
				431	.67±.09	410	.49±.12

Table 14--Continued

		+.70 and Over		+.50 to +.70		+.30 to +.50	
Age	N	Item No.	r	Item No.	r	Item No.	r
				435	.76±.06	412	.47±.10
				436	.60±.09	413	.47±.10
						429	.46±.12
						430	.47±.14
						439	.47±.12
5½	22	62	.70±.06	271	.55±.10	260	.42±.11
		153	.87±.00	280	.50±.11	261	.42±.13
		174	.70±.06	288	.67±.07	269	.46±.11
		179	.97±.04	294	.60±.07	285	.42±.13
		191	.71±.04	373	.66±.07	352	.42±.12
		200	1.00±.07	393	.66±.07	392	.49±.11
		208	.86±.01	394	.60±.07	413	.40±.12
				411	.61±.09	416	.36±.12
				417	.50±.10	422	.37±.12
				429	.56±.10	436	.42±.12
				430	.60±.09	439	.47±.12
				441	.55±.10		

Table 15--Selected Items (Forms A and B)

Ages 1½-2½:	Digit Span Incomplete Pictures* Mutilated Pictures Response to Pictures (naming nouns only) Imitative Drawing† Block Building: tower
Ages 3-4:	Tracing a Form Block Building: 3- and 6-cube structures Colors Discrimination of Forms Definitions Picture Puzzles: rectangular series
Ages 4½-5½:	Giving Word Opposites Absurdities Directions Picture Puzzles: diagonal series Knox Cube Imitation Vocabulary

*Found good in B only. Used in both A and B in validation.

†Found good in A only. Used in both A and B in validation.

V. VALIDATION

Turning then to the Alpha Validation Group of forty-six cases, the next step was to calculate, for each age level and each form, the correlation between the total number of items passed on the original scales and the Alpha scores and the correlation between the selected items and Alpha scores. Rank order correlation (rho) was used because of the very small number of cases available at each level. To secure larger numbers of cases, results from combinations of two and three age levels were also calculated. However, changes with age are so rapid during the preschool period that combining into one group children who vary in age by as much as one year gives undue advantage to the older children and tends to decrease the correlation. The use of the IQ-Equivalents would have solved this difficulty for the total scale correlations, but no IQ-Equivalents exist for the selected items and therefore comparisons between the total scales and the selected items would not be possible. Tables 16-18 give the comparison of correlations of the total item count (number of items passed from the total scale) with the Alpha scores; and the selected item count (number of selected items passed) with the Alpha scores. This was done for each age level of each form separately, and for combinations of two and three age levels.

Table 16--Comparison of Correlations of Total Items and Selected Items with Criterion (Alpha) Scores*

FORM A				FORM B			
Ages	N	Total Items	Selected Items	Ages	N	Total Items	Selected Items
1½ ...	3	-.50	+.50	1½ ...	3	-1.00	-1.00
2	4	+.40	+.40	2	4	+.80	+.80
2½ ...	2	....	....	2½ ...	6	-.14	-.69
3	8	-.10	+.02	3	4	+.40	+.40
3½ ...	5	-.10	+.17	3½ ...	6	-.40	-.40
4	6	-.03	+.26	4	4	+.49	-.37
4½ ...	6	+.94	+.77	4½ ...	6	+.71	+.81
5	7	+.56	-.18	5	4	+.40	+.35
5½ ...	7	+.18	+.43	5½ ...	5	+.40	+.40

*These correlations are based on the cases of the Alpha Validation Group--the 46 cases, selected at random from the total group tested, which were not used for the selection of items. The N's do not total 46 since some children had tests at more than one age level.

VALIDATION

Table 17--Comparison of Correlations of Total Items and Selected Items with Criterion (Alpha) Scores*
(Two Age Levels Combined)

FORM A				FORM B			
Ages	N	Total Items	Selected Items	Ages	N	Total Items	Selected Items
1½,2 ..	7	+.21	+.57	1½,2 ..	7	+.37	+.29
2½,3 ..	10	0	+.11	2½,3 ..	10	+.27	+.39
3½,4 ..	11	+.34	+.38	3½,4 ..	10	+.43	+.14
4½,5 ..	13	+.52	+.16	4½,5 ..	10	+.51	+.46
5½	7	+.18	+.43	5½	5	+.40	+.40

*See note, Table 16.

Table 18—Comparison of Correlations of Total Items and Selected Items with Criterion (Alpha) Scores*
(Three Age Levels Combined)

FORM A				FORM B			
Ages	N	Total Items	Selected Items	Ages	N	Total Items	Selected Items
1½,2, 2½ ..	9	+.32	+.62	1½,2, 2½ ..	13	+.41	+.43
3,3½, 4 ...	19	+.34	+.39	3,3½, 4 ...	14	+.24	+.09
4½,5, 5½ ..	20	+.39	+.20	4½,5, 5½ ..	15	+.47	+.46

*See note, Table 16.

In a further attempt to eliminate the age factors and make it possible to combine all cases over the entire age range, partial correlation was tried, using the following variables: (1) score on the preschool test, (2) age at taking the preschool test, (3) score on the Alpha test, and (4) age at taking the Alpha test. Second order partial correlation with both age factors cancelled out yielded minus values. Correlation between age at first test and score on first test in terms of the total item count or selected item count was so high that other relationships did not emerge. Inspection of some of the zero order correlations suggests also that the relationships between some of the variables are not rectilinear, and thus the use of partial correlation is invalidated.

Another age factor makes combination of age groups a questionable procedure. Because only sixteen years had elapsed since collection of the preschool data was begun, only subjects who were under 18 when the Alpha test was given could have taken tests when they were 1½ years of age; therefore, those tested at the earliest ages have lower Alpha scores than those who entered the preschool program at later ages, and consequently were older at the time of the Alpha testing. The group who took the preschool tests at the later ages only include subjects who took the Alpha over the total range of ages in the sample, from 16½ to 22 years of age. Owing to the narrower range of Alpha scores at the younger ages, the differences are probably more discriminating than those found at the older age levels.

In the light of these considerations it is with some misgivings that the correlations for all ages combined for total item count with the Alpha scores compared with the correlations for all ages combined for selected items with the Alpha scores are given in Table 19.

Table 19--Comparison of Correlations of Total Items and Selected Items with Criterion (Alpha) Scores (All Ages Combined)

FORM A				FORM B			
Ages	N	Total Items r*	Selected Items r	Ages	N	Total Items r	Selected Items r
1½-5½..	48	+.31	+.25	1½-5½..	41	+.33	+.35

*All r's Pearson product-moment formula.

As would be expected because of lack of control of the age factors, the correlations are rather low. It is true that the positive relationship between age and score on the Alpha test would tend to increase the correlations. However, it seems probable that the use of the item count as a score on the preschool tests far outweighed the effect of the positive relationship between age and score on the Alpha. The use of the item count gives a decidedly greater advantage to older children and therefore tends to decrease markedly the total correlations. Also, a sampling error in the middle age range (ages 3, 3½, and 4) lowers the total correlations. That the negligible correlations shown in the middle age range (see Table 16) are due to sampling errors, rather than to lack of items with predictive value at those age levels or to some intrinsic change in children of those ages, is shown by inspection of correlations for comparable

Table 20--Comparison of Correlations of Total Items and Selected Items with Criterion (Stanford-Binet) Scores

FORM A				FORM B			
Ages	N	Total Items	Selected Items	Ages	N	Total Items	Selected Items
1½ ...	2	....	....	1½ ...	2	....	....
2	3	+.50	-.50	2	4	-.40	-.40
2½ ...	5	+.60	+.64	2½ ...	5	+.60	-.20
3	6	+.53	+.64	3	4	-.65	-.65
3½ ...	7	+.78	+.72	3½ ...	5	+.60	+.10
4	13	+.59	+.05	4	10	+.75	+.54
4½ ...	5	+.10	+.10	4½ ...	4	+.80	+.80
5	13	+.74	+.73	5	10	+.79	+.92
5½ ...	11	+.75	+.71	5½ ...	4	-.40	-.80

ages, using various predictive measures presented in Mental Growth from Two to Fourteen Years, Part II (42) on a much larger and more adequate sample. The correlations there do not show any peculiarity at those age levels; rather, there is a gradual upward trend with increasing age at first test.

Tables 20-23 show the corresponding correlations at individual age levels and for combined groups in both forms for the Binet Validation Group. Correlation of Alpha scores and Stanford-Binet IQ's for 134 cases on whom both scores were available yielded a value of +.57. A correlation of this magnitude on this fairly homogeneous sample indicates that these tests are at least to some extent measuring the same abilities.*

To determine the effect of the inclusion of enough items of the same type as those found to have high predictive value, in order to restore the scale to its original length, the appropriate formula in Kelley (58, p. 200) was applied. A reliability coefficient was obtained by correlating the selected item count for 20 children who had had Forms A and B of the scale at the same ages. The coefficient obtained was +.80, remarkably high for a small sampling of homogeneous cases. The correction was therefore negligible, for it raised the correlations only a point or two. Obviously the reliability of the Minnesota Scales (for the standardization group an average reliability coefficient of +.89 was reported for the total scale) is so high for the total score or any part of that score that the addition of more items of the same type will not increase its validity. To do so new and different items will have to be added.

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*The correlation between Alpha and 1937 revision ($N = 50$, $r = +.67$) was considerably higher than for the 1916 revision ($N = 84$, $r = +.47$). The difference is probably a reflection of efforts to improve the new test at the upper ages.

Table 21--Comparison of Correlations of Total Items and Selected Items with Criterion (Stanford-Binet) Scores (Two Age Levels Combined)

FORM A				FORM B			
Ages	N	Total Items	Selected Items	Ages	N	Total Items	Selected Items
1½,2	5	-.10	-.30	1½,2	6	-.49	-.44
2½,3	11	+.44	+.55*	2½,3	9	+.08	-.04*
3½,4	20	+.42	+.11	3½,4	15	+.58	+.46
4½,5	18	+.56	+.59	4½,5	14	+.74	+.81
5½	11	+.75	+.71	5½	4	-.40	-.80

*Both items selected for 1½, 2, 2½, and 3, 3½, 4 groups used.

Table 22--Comparison of Correlations of Total Items and Selected Items with Criterion (Stanford-Binet) Scores (Three Age Levels Combined)

FORM A				FORM B			
Ages	N	Total Items	Selected Items	Ages	N	Total Items	Selected Items
1½,2, 2½ ..	10	+.05	-.11	1½,2, 2½ ..	11	+.03	-.11
3,3½, 4 ...	26	+.39	+.17	3,3½, 4 ...	19	+.35	+.22
4½,5, 5½ ..	29	+.65	+.68	4½,5, 5½ ..	18	+.69	+.74

Table 23--Comparison of Correlations of Total Items and Selected Items with Criterion (Stanford-Binet) Scores (All Ages Combined)

FORM A				FORM B			
Ages	N	Total Items r*	Selected Items r	Ages	N	Total Items r	Selected Items r
1½-5½	65	+.18	+.27	1½-5½	48	+.11	+.14

*All r's Pearson product-moment formula.

VI DISCUSSION OF THE RESULTS

General Requirements in Tests for Young Children

Constructors of mental tests and clinicians agree that to gain the cooperation and best efforts of preschool children, tests designed for them must be intrinsically interesting. Older children can be motivated by appealing to their spirit of competition and pride in performance, but the little child must want to comply. Tests must be short and varied if the child's interest is to be maintained. Except in tests designed to measure comprehension, directions must be brief and simple in order that all children understand what is required of them. Tests that produce self-consciousness should be eliminated entirely, since the emotion provoked defeats the purpose of the test.

Types of Material Suitable for Use

Kuhlmann (59) classifies intelligence test items in the following manner: those which sample previously acquired knowledge; those which demand a new use of previously acquired knowledge; and those which require a new mental operation entirely independent of previously acquired knowledge and skill. The first type of item is less suitable for young children than for older children. Opportunities for acquiring information are less constant for preschool children than for children of school age. Verbal expression is also limited. The brief time they have had to practice their newly acquired ability to use symbols places a further limitation on this type of item. The third type is ideal, since it eliminates the factor of varying experience, which may place some children at an advantage, and also requires adaptation to a new situation, considered indicative of intelligent behavior since Binet's time. No doubt tests of this type have much to recommend them, but they are also rare, and it would be exceedingly difficult to find enough of them to make up a scale of general intelligence. The second type of item mentioned by Kuhlmann shares the advantage of requiring a new adaptation but has the disadvantage of not eliminating the factor of differential opportunities to acquire the knowledge and skills required to accomplish the task.

Verbal versus Nonverbal Test Items

On the basis of the item analysis, seventeen of the twenty-nine tests were retained. (See Table 24.) Of these seventeen, eight are classified as nonverbal (requiring no

Table 24--A Comparison of the Predictive and Nonpredictive Tests

Predictive Tests	Nonpredictive Tests
Imitative drawing*	Pointing out parts of the body
Block building (2 parts)	Pointing out objects in pictures
Response to pictures (nouns)	Naming familiar objects
Knox cube imitation*	Copying drawings (borderline)*
Discrimination of forms*	Response to pictures (verbs)
Naming colors	Obeying simple commands
Tracing a form*	Comprehension
Picture puzzles (rectangular)*	Naming objects from memory
Incomplete pictures	Aesthetic comparisons
Digit span	Recognition of forms (borderline)*
Picture puzzles (diagonal)*	Paper folding*
Definitions	Imitating position of clock hands
Absurdities	Speech
Mutilated pictures*	
Vocabulary	
Comprehension of directions	
Giving word opposites	

* Nonverbal tests.

language response) and nine as verbal. Since there were only twelve nonverbal tests in the original scale, it is at once obvious that a larger proportion of nonverbal than of verbal tests were selected. Furthermore, two of the four nonverbal tests eliminated were borderline exclusions. More of the nonverbal tests appear at the younger age levels, while the verbal tests are found at the older age levels. From the item analysis it is easy to see why the nonverbal score of the scale showed a predictive value as high as, and in some comparisons slightly higher than, the verbal score when compared with later tests reported in the 1942 monograph (42).

Nonpredictive Items

In discussing the tests that were not predictive it should be remembered that the fault may be in other factors than the task required. Modifications of procedures for giving or scoring tests might bring some of the borderline failures into the predictive group. Also, certain tests passed by either extremely small or large proportions of the children at the limits of the age range might be predictive at earlier or later ages.

Pointing out parts of the body, its modern variation, pointing out objects in pictures, and naming familiar objects are tests found in most scales for young children. Yet these tests lack predictive value for this group of superior children, though one or two items in each form have high biserial r's based on a small number of cases. One explanation of their failure to predict is that they require skills overlearned by the time the child has reached the age at which the tests appear in the scale. Acquiring such information undoubtedly requires intelligence, and at earlier ages and for less superior children such tests may be predictive. However, they lose predictive value rapidly, for the responses once thoroughly mastered can be produced in parrot-fashion without use of the higher mental processes. On the other hand, such tests may prove to have little predictive value at any age, because the abilities called for are too susceptible to variations in training. Some parents make a great effort to accelerate the language development of their offspring, once comprehensible speech has emerged, by putting them through a series of simple drills. In the experience of the writer this is very often the case with adopted children whose parents are overanxious that they make a good impression on adults outside the family, and also among parents of enough sophistication to appreciate partially the significance of language development as an indication of intelligence. It is possible, therefore, that what we are getting in response to items of this sort is a measure of parental concern and the child's docility rather than of intelligence. Also, verbal fluency and talkativeness vary tremendously in young children as well as in older individuals, and within broad limits seem to be more closely allied to differences in personality than to differences in intelligence.

Response to pictures (a predictive test for naming of nouns, a "borderline" failure for naming verbs and prepositions) demands more than the naming of individual objects presented separately. In this test the child must pick out objects as well as name them and is encouraged to make statements regarding the relationships of the objects to one another and to describe the action shown or implied. This test would probably be improved by the elimination of the object-naming tests, since many children fail to elaborate their responses to this test because of the set for merely naming objects, already found sufficient to gain the approval of the examiner.

Obeying simple commands also failed to discriminate. Most children who understood what was required could do the tasks, and again training rather than use of the higher mental processes seems to be the deciding factor. The test content is such that it has been overlearned by most children of these ages. Well-trained children comply. So would a well-trained dog presented with items within the limits of his ability. Overtrained children resist. The simpler tests in the new Binet scale at the 3½-year level may be better, in that the commands are novel to the child, have no particular utilitarian value, and do not involve ordinary household activities, and thus are not likely to have been practiced before. Commands involving two or three tasks were too difficult for these children, many of whom failed to grasp the significance of doing the tasks *in order*.

None of the *comprehension* questions discriminated between intelligent and less intelligent children as determined by terminal status as a criterion. Again, the answers to the first two may have been overlearned. The third question (Form A: "What should you do if your house is on fire?" and Form B: "What's the thing for you to do if you miss the trolley?") was apparently very largely affected by variable experience. Some of these carefully reared children had never seen a fire, much less experienced it as a hazard in their own homes. Many had been deliberately kept off public conveyances as a precaution against infection. All comprehension questions share the disadvantage of being particularly susceptible to variations in both experience and customs from one section of the country to another and from one period to another. They easily become "dated." If allowances are made for these factors, objectivity in scoring, another requirement of good items, cannot be secured.

Aesthetic comparisons, a test originated by Binet and used in most Binet revisions including that of 1937 (86), failed to discriminate between bright and dull children in this study. The child is required to pick out the prettier of two pictures. He may fail to make the necessary discriminative judgment, or his failure to pass this test may be explained as a reaction to beauty which has not yet become stereotyped. The younger children pass or fail by chance alone, and those a little older tell the examiner which picture they *prefer*, frequently adding such remarks as, "That looks like my Aunt Sue." The child's preference is quite as likely to be for the ugly picture as for the pretty one. So far as the little child is concerned people who are familiar and liked are "pretty," or are endowed with any other quality suggested as favorable. The older child picks out the right picture without hesitation because he has learned what is expected. It is knowledge of the stereotype rather than judgment that determines success at later ages. (This test was not retained in the published scale.)

Speech as a test item was added to the child's score by simply using any response made in the hearing of the examiner which demonstrated that the child could speak single words (1 point) or combine words in a simple sentence (2 points). Some of the young children made low scores on all verbal tests because they were slow in learning to talk. As Bayley (12) points out, the age of the emergence of speech is apparently not significant as an indication of degree of intelligence among normal children, though severely retarded children never master the fundamentals of language. Predictive value of many of the verbal tests requiring complicated speech responses at the older age levels indicates that while age at the emergence of speech and the rapidity of passing through the early stages of speech are not predictive, the use of speech after it becomes stabilized is highly significant.

Naming objects from memory does not have predictive value probably because of the complexity of the directions. Many children fail half the items before comprehending what is required. It becomes a case of confused comprehension rather than a delayed response test. Some interference from the earlier naming-objects tests occurs here too. It is difficult to maintain a child's interest in this test. In an effort to do so the examiner frequently resorts to such a show of enthusiasm that the game is uppermost in the child's mind, and he misses the importance of the essential part of the task. He says just anything that comes into his head and then he and the examiner play another of these games that she seems to find so amusing! A similar test with simpler directions in the new Binet may have greater predictive value.

Elimination of the recognition of forms test, similar to but more difficult than discrimination of forms, is probably also due to complicated and confusing directions. The child is told to look at a geometric form carefully so as to be able to identify it among many similar forms. Saying the directions is planned to take five seconds, which is the time for exposing the object to the child. To keep the attention of the very young child on an object to be recognized while the examiner is talking to him makes this a very difficult and unsatisfactory test from the point of view of administration. It is almost impossible to tell whether or not the child looks at the form for the permitted five seconds.

One other test was found to be nondiscriminating on the basis of test procedure and the motor skill involved. This is the imitation of clock hands test. The child is required to imitate with his own movements the positions of the hands of a clock. The child represents his perception of the spatial relationships so poorly with fingers, hands, or arms that his response is almost impossible to score, and scoring standards have been made so lenient as to be meaningless. This test might be a useful one if some other method of getting the child's response could be devised. There seems to be no reason other than difference in procedure why imitative drawing is a predictive test, while imitation of clock hands is not.

The relative lack of emphasis on motor tests in the Minnesota Preschool Scales probably accounts for the high biserial r's of many of the items for younger children. Just as language must become stabilized before it can be used as a means of discovering a child's intelligence, tests that require motor manipulation are useful only after the child has acquired sufficient motor skill to accomplish the tasks involved. Several paper folding tests were included in the scale originally and in each instance were found nondiscriminating. Similar tests at later ages are assumed to have some validity, although they have not been subjected to detailed analysis. The object of the motor tests included in the Minnesota Scale is to see if the child can imitate the movements made by the examiner in such a way as to produce the same result. This is a task of perception, memory, and imitation, probably quite similar to picture puzzles and block building tests and directions tests, all of which are valid. From watching children try to perform this task, I suspect that the reason for many complete failures is not lack of memory or of perception but the difficulty of the motor coordinations required. By the time the child has fumbled with the paper and lost hold of the corners and accidentally creased the paper in the wrong places through sheer clumsiness, it is small wonder that he has forgotten the original task and gives up in disgust. The difficult motor manipulation has distracted his attention from the goal. The coordinations required in building the block structures and in putting puzzles together are much simpler and have been mastered by most 2- and 3-year-old children. Even success on the drawing and tracing tests seems more dependent on perception of spatial relations and ability to imitate either observed or deduced movements of other persons than on motor skill. The tracing test seems more dependent on the child's control of his attention than on control of his fingers.

Copying drawings is the only remaining nonpredictive test, a borderline failure. Two of the drawings in each series were too difficult for most of these children. The other was fairly good but did not quite meet the criterion. Perhaps bright young children have more difficulty with drawing tests than older children of the same mental ages because of the motor coordinations involved.

Predictive Tests

Imitative drawing as scored in the Minnesota Preschool Scale requires a minimum of motor skill. As long as the child moves his pencil in approximately the right direction he passes the test. The crux of the matter is his ability to imitate the movement. *Block building* tests also require only the simplest of motor coordinations. Again success depends on the child's ability to imitate the examiner in placing the blocks to reproduce the structure he sees. For this test he must appreciate a slightly more complicated goal and find his way to it, but emphasis is on perception and ability to reproduce movements rather than on motor skill. In the *Knox cube imitation* test the child must perceive, remember, and reproduce the spatial relationships.

As mentioned earlier, the *tracing a form* test appears to be more a test of controlled attention than of motor skill, though motor skill enters in more than in any other test in the predictive group. *Discrimination of forms* requires perception and controlled attention also, since the child must find each form on a card of twelve. *Response to pictures* also has a large perceptual element and requires as well a vocabulary sufficient for naming with reasonable accuracy the objects discriminated.

The *color naming* test is one which is found to be highly predictive within a very narrow age range (approximately 3 to 4 years, with the greatest value at 3½). This test is an example of those that might be eliminated as discriminating only at one mental age, but it is highly predictive at 3½. There is apparently a stage in mental development when to discriminate among different colors *and* name them is indicative of intelligence. After the age of 4, practically all normal children who are not color blind can perform this task.

That the *digit span* test should be good at the early levels was a surprise. This test comes nearest to the type considered most desirable by Kuhlmann. The task is entirely new to most small children. If they have been taught numbers they have usually been taught them in order. No amount of practice has been found very successful in increasing the digit span. Carefully selected nonsense syllables might provide an equally valid alternate for this test. The attention factor is probably dominant in determining success. The fact that this test requires no motor response and a minimum verbal response makes it useful at very early ages.

Guessing *incomplete pictures* and *mutilated pictures* appears to require perception of a whole and ability either to supply the whole, give a part through redintegration, or name the missing part needed to complete the whole. These tests are thus largely perceptual problems. *Picture puzzles* of both the rectangular and diagonal series were found predictive and were among the most attractive to preschool children. Interestingly enough, most of the children appear to fit the pictures together by matching forms rather than using the pictures as cues. Often they seem to be entirely surprised at the result in terms of the picture, though older children check the accuracy of the results by the pictures. As with the preceding tests, perception of a spatial whole is necessary for the child to persist in finding the pieces that make that whole and putting them in correct relationship to one another.

The *comprehension of directions* test was originated by Kuhlmann. In some ways it resembles the eliminated paper folding test, though the motor coordinations are simpler The child must be able to deduce movements that will get his pencil from one named point (upper right, lower left, etc.) to another. It demands controlled attention, memory, and deductive reasoning. This test closely approximates Kuhlmann's ideal. The child is taught on the spot the materials to use (spatial directions), and he then makes an entirely new use of them. At the later age levels this test had the highest predictive value of all the tests.

Little need be said concerning the other tests that were found predictive at the later age levels: *definitions*, *vocabulary*, *absurdities*, *giving word opposites*. All are found in tests that have high predictive value for school age children and adults. It would be surprising had they failed to predict. All require both comprehension of language at an advanced level and doing something new with previously acquired knowledge and skill.

Nelson and Richards (70) describe as "awareness" or "adaptive" behavior items given at 6 months of age which predict standing at 2 years on the Merrill-Palmer and at 3 years on the Stanford-Binet. Tests given at 12 months failed to add to the predictive value of the total scores (72). A factor analysis of seventeen items in the middle range of difficulty selected from the tests given at 6 months yielded three factors (71). These were tentatively called (a) "testability" or "halo effect," (b) alertness, and (c) motor ability. The first factor was considered to be a temporary set having no relation to intelligence. The factor analyses made by McNemar (64) at the 2½-year age level yielded (a) a general factor, (b) a motor or memory factor, and (c) an identifying factor. Later analyses yielded only the general factor at most ages.

Tests at 3- and 6-month age levels found predictive of 5-year Stanford-Binet IQ by L. Dewey Anderson (5) are described as "positive reactions to happenings in the immediate field and the beginning of contactual exploration." The similarity of these findings to those of Nelson and Richards at the 6-month level is apparent. In his analyses Anderson also found few items of predictive value at 9 and 12 months. By 18 months, imitative behavior had emerged as predictive. The suggestion of the present study that simple language tests are predictive at earlier ages is borne out by the results of Anderson, who found them predictive at 18 to 24 months for a slightly less superior sample. Several items included in Anderson's list of predictive items at 18 to 24 months are similar to selected items of the present investigation: building a tower (identical), guessing an incomplete picture (a different picture but the same task), and solving a dissected picture puzzle.

To summarize, the tests retained as a result of this study differ from those eliminated in the following ways: Tests for younger children make only minimal demands on language. They require perception of form and spatial relationships and the ability to reproduce them. They do not demand complex motor coordinations. They require controlled attention and ability to persist to a goal. Many of them are comparatively independent of training. Tests for older children involve use of language in relationships which are not often practiced and constitute problem-solving situations involving the use of well-developed tools. Only two tests (response to pictures and naming colors) seemed to test skills in the early stages of formation. These two tests were highly predictive at certain ages and then dropped completely out of the scale. Several tests could probably be salvaged from the nonpredictive group by simplifying directions; several others are possibly predictive at earlier or later ages.*

It is interesting to note how closely the description of the items found to be predictive in this study matches the three major characteristics of intelligent behavior according to Binet: (1) the ability to take and maintain a given mental set; (2) the capacity to make adaptations for the purpose of attaining a desired end; and (3) the power of autocriticism. Most of the predictive tests require attention and adaptation, considered by Binet the most important factors in general intelligence. Though the power of autocriticism is less obviously measured by the tests, every experienced examiner has seen the ability in operation in the intelligent child's performance. For example, one little girl who failed to draw a square from a model after succeeding in reproducing a circle looked up finally and said, "I can't do it but I know it has four sides." Undoubtedly autocriticism operates unobserved in helping the child to select the correct response in most of the problem-solving tests. It would seem to this writer that, though considerable progress has been made in its measurement, we have not progressed very much farther than Binet's genius carried us forty years ago in understanding the nature of intelligence.

Comparisons of the Correlations of Selected and Total Items with the Criterion

Tables 16-19 show that the correlations of the selected items with the Alpha are just about the same as for the total scale. Correlations for single age groups are erratic because of the small numbers of cases; however, a number of them are identical for selected and total items. Apparently the nonpredictive items have a zero but not a negative relationship to the criterion, and therefore contribute nothing and subtract nothing from the predictive value of the scale. They must be considered dead wood, and should be removed in the interests of economy of time. Failure of correction for the greater length of the complete scale* to bring about an appreciable increase in correlation with the criterion indicates that new and different items must replace the nonpredictive items if greater validity is to be achieved. Tables 20-23 indicate similar findings with respect to prediction using the Stanford-Binet as the criterion.

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*Since this manuscript was sent to press, a study by Katherine P. Bradway, "Predictive Value of Stanford-Binet Preschool Items," has appeared in the Journal of Educational Psychology, 1945, 36:1-16.

Effects of Age and Interval on the Correlations

While there appears to be no consistent trend with age at first test in the correlations with the Alpha test (either for selected or total items), correlations with the Stanford-Binet test show a marked relationship to age The relationship to age is even more marked for selected items than for the total scale; possibly this is because the large number of nonverbal items retained in the selected tests reduces similarity of content at the earlier ages to that of the Stanford-Binet. The Stanford-Binet test is largely a verbal test; the Alpha test is about evenly divided between verbal and nonverbal content. While differences and similarities in content may partially explain these age trends, there appears to be no completely satisfactory explanation of their occurrence in some comparisons and not in others. Table 25 describes briefly the findings with regard to the effect of interval and age in five of the more recent predictive studies, including this one. Some of the results seem to agree; others are discrepant.

Some tentative generalizations can be made: (1) Comparisons involving the Stanford-Binet, an age scale, tend to have a marked relationship to age, i.e., r's increase with increasing age at first test; (2) comparisons in which Stanford-Binet or California Preschool Scale are correlated with later Stanford-Binet reveal a marked inverse relationship to interval; (3) when Minnesota Preschool Scale and Merrill-Palmer are compared with Stanford-Binet there is no relation to interval; (4) when Minnesota Preschool is compared with Arthur or Merrill-Palmer there is a relationship to age, though not so marked as for the verbal tests, but none to interval; correlations for test-retest on the Merrill-Palmer and for Merrill-Palmer with other performance tests show only slight relationships to age and interval; (5) the Alpha alone shows no relationship to age. (Data on the effect of interval are not available from the

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* Kelley (58). $r_o(af) = \dfrac{r_o}{\dfrac{1 - r_{iI}}{a} + r_{iI}}$

Table 25--Findings with Regard to Age and Interval: Five Studies

Author	Relationship to Interval	Relationship to Age	Test	Retest
Goodenough and Maurer	None	Marked at earliest age	Minnesota Preschool Scales	1916 and 1937 Stanford-Binet Merrill-Palmer Arthur Performance Scale College Aptitude Test
Maurer	?	None Marked	Minnesota Preschool Scales Minnesota Preschool Scales	Revised Army Alpha 1916 and 1937 Stanford-Binet
Ebert and Simmons	Marked	Marked	1916 and 1937 Stanford-Binet	1916 and 1937 Stanford-Binet
	Slight	Slight after 2	Merrill-Palmer	Merrill-Palmer
	None	None	Merrill-Palmer	1916 and 1937 Stanford-Binet
	Slight	Slight none after 2½	Merrill-Palmer	Performance tests
Honzik	Marked	Marked	California Preschool Scales California First Year Scale	1916 Stanford-Binet 1916 Stanford-Binet
Bayley	Marked	Marked	California Preschool Scales	1916 Stanford-Binet

Alpha-Minnesota comparison.) It might be mentioned here that the Binet and California Preschool Scale A are age scales,* whereas the Minnesota, Merrill-Palmer, Arthur, and Alpha are point scales. It has been suggested by Ebert and Simmons that the principle of overlap may not operate when different tests are compared, but this is contradictory to other evidence. Retests on the Minnesota show no effect of interval; Merrill-Palmer test-retest results show only a very slight effect of interval.

Can it be that the effect of interval is peculiar to age scales? Do point scales with calibrated units fail to show the interval trend because overlapping of content has been controlled, i.e., made constant at all ages? This is not, of course, the case with age scales made up of mental age units, which are probably of varying significance from age to age. And why is the Minnesota-Alpha comparison unique in showing no relation to age at first test? No conclusive answers can be given at present. Since these issues have great theoretical importance, it is to be hoped that they will be clarified by further investigation.

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*That the California Preschool Scale A is primarily an age scale is assumed from the method of scoring given in the manual. It is regrettable that standardization data are not given. Similarity of content from age to age (difficulty varied) is sought for in this scale.

VII. INTERPRETATION

The use of terminal status as a technique for the elimination of noncontributing elements in mental tests appears to be successful. The biserial correlations for separate items showed very definite patterns: similar items in the same scale (and similar items in both forms of the test) showed high biserial r's with terminal status. Similar tests of increasing difficulty tended to show a similar degree of relationship to the criterion. An attempt to make psychological sense of the differences between predictive and nonpredictive items was also successful. Eliminated items made too heavy demands on motor or language skills at early ages or were too easily affected by variable experience, or the procedures for administration and scoring were faulty. When several of the current mental growth studies have continued for a few more years, this method of analysis can make a wealth of information with respect to the predictive value of many different test items available. With larger and more representative samples than were available for this study even finer discriminations can be made.

Perhaps the most striking result of this study is the evidence it gives of a constant core of mental functioning. While it must be tapped by methods suitable to the stages of growth of children of varying ages, this constant core is readily identified as the purpose of the tasks chosen for use at different ages. In some instances the tests themselves are identical at all ages. Memory for digits, useful as early as 1½ years, has been shown to make mental distinctions at the adult level as well. Giving word opposites appears to be as good a test at 4½ to 5½ as it is at the college level. A graded series of picture puzzles and of block designs could be made to cover the entire span of mental growth. Directions tests, differing in specific content, but requiring similar mental operations, are good at all age levels. Examples could be multiplied. Even the few tests which appear to be valid only at one age can be grouped together as requiring one general mental characteristic--adaptability to a novel situation.

It seems to me probable that we shall eventually succeed in predicting the terminal intellectual status of young children well enough for practical purposes. But to attain this success, painstaking and time-consuming analyses must be made of individual items of many types. The present writer does not agree with L. Dewey Anderson (5) that all possible items have been devised. Much less have all existing items been subjected to analyses. It is to be hoped that future investigators will go beyond merely comparing IQ's or any other total measures based on heterogeneous items, the significance of which has not been determined. All that can be learned by such rough comparisons has already been discovered.

Evidence of the stability in mental functioning contained in this study strongly supports Spearman's "g" hypothesis. What is required now is more accurate measurement of "g" at early ages. Once this has been accomplished, initial status may equal terminal status as a criterion of intellectual potentiality.

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APPENDIX A

Interests Questionnaire

Name ______________________________
(Last) (First) (Middle)

Address ______________________________ Phone __________

Birth Date ______________________________
(Month) (Day) (Year)

Age at last birthday ______________________________

Father's Name ______________________________

Occupation ______________________________

Mother's Name ______________________________

Occupation ______________________________

Vocational Interests: ______________________________

If you are employed full time, state in detail what kind of work you are doing. ______________________________

____

How long have you been working at your present job?

____
(Years) (Months) (Weeks)

Do you like the work you are doing? Yes_____ No_____ If not, why not? ______________________________

If you are not satisfied with your present job, what work would you rather do if you could get it? ______________________________

____

List the other kinds of work you have done, either full time or part time, and indicate by checking those that you liked:

Work	Liked
______________________________	__________
______________________________	__________
______________________________	__________

Do you expect to go on working at your present job indefinitely? ______________________________

If not, what do you plan to do (such as, leave to go back to school, take special training, leave for another job, etc.)? ______________________________

APPENDIXES

Educational Experience and Interests:

Encircle the last grade you have completed:

Grade School: 4 5 6; Junior High School: 7 8 9;

High School: 10 11 12; College: 13 14 15 16;

Graduate School: 17 18 19.

List any other schools you have attended (such as business school, vocational school, nursing, etc.) full time, and give the approximate length of time you were in attendance:

Name of School   Attendance (in weeks, months, years)

____

____

____

List any other special training you have had, not full time (such as music lessons, boxing, dancing, art, etc.) and give the approximate length of time this training covered:

Special Training   Time Covered

____

____

____

a. Check in the first column the subjects on the list below which you have taken or are now taking in high school or college. Write in the blank spaces any subjects you have studied or are now studying which are not included on the list.

b. Check in the second column those subjects which you have particularly enjoyed.

Subject	Taken	Liked	Subject	Taken	Liked
Algebra	___	___	Botany	___	___
Anatomy	___	___	Business	___	___
Anthropology	___	___	Chemistry	___	___
Architecture	___	___	Child Welfare	___	___
Art	___	___	Chorus	___	___
Astronomy	___	___	Civics	___	___
Bacteriology	___	___	Cooking	___	___
Band	___	___	Dramatics	___	___
Biology	___	___	Economics	___	___

SELECTING ITEMS IN PRESCHOOL TESTS

Subject	Taken	Liked
Education	____	____
English Composition	____	____
English Literature	____	____
French	____	____
Geography	____	____
Geology	____	____
Geometry	____	____
German	____	____
Greek	____	____
Higher Algebra	____	____
History	____	____
Home Economics	____	____
Industrial Arts	____	____
Italian	____	____
Journalism	____	____
Latin	____	____
Mathematics	____	____
Music	____	____
Orchestra	____	____
Orientation	____	____

Subject	Taken	Liked
Philosophy	____	____
Physical Education	____	____
Physics	____	____
Physiology	____	____
Political Science	____	____
Psychology	____	____
Sewing	____	____
Shorthand	____	____
Spanish	____	____
Speech	____	____
Social Science	____	____
Social Work	____	____
Sociology	____	____
Trigonometry	____	____
Typing	____	____
Zoology	____	____
____________	____	____
____________	____	____
____________	____	____
____________	____	____

c. List any extracurricular activities in which you have participated during high school and college (such as, writing for the school paper and yearbook, singing with the glee club, business manager of an athletic team, etc.): ______________________________

____

____

____

d. If you are no longer in school, give your reason or reasons for leaving school (such as, lost interest, got a job, got married, etc.): ______________________________

____

____

____

APPENDIXES

Recreational Interests:

Check the activities on the following list in which you engage for fun. Add in the blank spaces any leisure-time activities you have which are not on the list:

Check Activity

______ Bridge
______ Other card games
______ Camping
______ Social clubs
______ Study clubs
______ Crossword puzzles
______ Cooking
______ Planning meals
______ Marketing
______ Dancing
______ Dramatics
______ Drawing and painting
______ Other handcrafts
______ Making clothes
______ Planning a wardrobe
______ Shopping
______ Athletic games (football, baseball, basketball, hockey, etc.)
______ Outdoor sports (swimming, skating, skiing, etc.)
______ Listening to the radio
______ Making things with tools (of wood, leather, metal, etc.)
______ Playing a musical instrument. What instrument do you play? ______________________
______ Singing
______ Reading news, fiction, nonfiction (underline)
______ Writing letters
______ Collecting stamps, coins, etc.
______ Writing stories, poems, etc.
______ Going to the movies
______ Walking
______ Picnics
______ Organizations (Scouts, De Molay, Y.W.C.A., etc.)
______ Church activities

____

____

____

____

____

What is your favorite leisure activity?____________________

Are your leisure-time activities satisfying to you?__________

If not, why not?____________________________________

Is there some one thing you would like to do which you cannot do at the present time?______________________________

Is so, what is it?__________________________________

____

____

APPENDIX B

Directions for Administering the Minnesota Preschool Scale

FORM A

I. Pointing out parts of the body. Show child the small doll. Let him handle it a moment, then say, "Show me the dollie's eyes. Put your finger on her eyes." If the child does not respond, ask, "Has the dollie any eyes? Look, find the eyes for me." Same for ears, nose, hands, chin.

Scoring. Score 1 for each feature correctly pointed out. If child points first to one feature, then to another, score on the basis of final choice, whether right or wrong. Total possible score is 5.

Limits of testing. The complete series should always be given.

II. Pointing out objects in pictures. Say, "Now I have some pictures to show you." Show card A, II. Say, "Where is the man? Put your finger on the man." (The word "daddy" may be substituted if child recognizes that term more readily.) Repeat and urge if necessary. If child does not respond, take his hand and put it on the man, saying, "See, there is the man. Now show me the chair." Urging is permitted; but no further help may be given after the first picture. Continue in same manner with apple, house, flower, horse. If pointing is not clear, say, "Which do you mean? Put your finger right on the ______."

Scoring. Score 1 for each picture correctly pointed out without help. If a spontaneous correction is made, score on the basis of the second choice in all cases, whether this choice is right or wrong. The total possible score is 6.

Limits of testing. The complete series should always be tried.

III. Naming familiar objects. Show child the ball, and say, "What is this?" Repeat and urge if necessary. Continue with watch, pencil, scissors, cup.

Scoring. Score 1 for each correct response, disregarding articulation. Infantile expressions such as "tick-tock" for watch are given full credit. Total possible score is 5.

Limits of testing. The entire series should always be tried.

IV. Copying drawings. Place the card with the circle before the child, together with pencil and paper. "Let me see you make a picture just like this." Point to circle but be careful not to trace outline with finger. When child has finished, say, "That is fine. Now make another one." Allow three trials in all. Follow same procedure with triangle and diamond.

Scoring. Credit 1 for each successful performance with each of the three forms. The circle is credited if the line loops back upon itself and is not carried more than halfway around again. The triangle is credited if there are three clearly separated sides and three well-defined angles with no rounded corners. The diamond is credited if the two lower sides are brought together by means of a single continuous stroke for each, and if the lateral angles are drawn without regressive movements so that they are free from the protuberances known as "ears." See scoring card for illustration of successes and failures with each of the three figures. The total possible score on this series is 9.

Limits of testing. Continue testing until a form is reached for which all three trials are failed.

V. Imitative drawing. Place pencil and paper before the child and say, "Now watch and see what I am going to make." Take the pencil and make a single vertical stroke about two inches long. Then hand the pencil to the child and say, "You make one like that." Urge if necessary. If no satisfactory responses can be elicited, repeat the illustration several times, or until it is obvious that the child cannot perform the task. Manual guidance is not permitted. Repeat the procedure using a horizontal stroke, and again a vertical cross.

Scoring. Credit is given for the vertical stroke if the child draws a line of any length and regardless of direction. The horizontal stroke is credited only if drawn in an approximately horizontal direction and if the preceding vertical stroke was drawn vertically so that the two are clearly differentiated. Length of line is disregarded. The cross is credited if the two lines cross at any angle regardless of size or symmetry. A credit of 2 points is given for each figure if the child imitates successfully after a single illustration. If more than one illustration is required, the score is 1. Total possible score is 6.

Limits of testing. If the score on the test of copying drawings (Series IV) is 3 or more, full credit of 6 points is allowed for this series without actually giving the tests. If the score on Series IV is less than 3 points, this series should always be given. Both the vertical and the horizontal strokes should be tried, but if these are failed, the cross need not be attempted.

VI. Block building. Place 6 one-inch cubes before the child, and say, "Now we are going to build something." With 3 of the cubes, build a pyramid while the child looks on. Then push the other 3 cubes toward him and say, "Now you make one like that." If he succeeds in copying the model, take 6 more cubes and build a larger pyramid, saying, "This time we'll make a big one." The model should be left so that the child can see it as he builds. Give only one illustration for each model, and allow one additional trial (but only one) if the first structure falls down before completion. Do not correct errors. Then pile 6 blocks one upon another, while the child watches. Say, "See if you can build a big high one like this." If tower falls down in process of construction allow one (but not more than one) additional trial.

Scoring. For the pyramids, allow full credit of 1 point for each model successfully completed on either trial, regardless of symmetry. Total possible score is 2. For the tower, credit 1 point for each block piled above the basal block. Total possible score is 5. Total possible score for the entire series is 7.

Limits of testing. If the first pyramid is failed, the second need not be attempted. If both pyramids are built, the tower may be credited without actual trial. If one or both pyramids are failed, the tower should always be given.

VII. Response to pictures. Place the first picture (girl and dogs) before the child and say, "Tell me what this picture is about. What is that a picture of?" Repeat if necessary. If there is no response after three repetitions, say, "Tell me everything you see in this picture." Repeat three times if need be. If child names one or two objects and then stops, urge him to continue by saying, "Go ahead, tell me all you can." Proceed in a similar fashion with pictures 2 and 3. Always present pictures in the same order.

Scoring. On each picture, score 1 for each different object named up to a total of 3 (no credit should be given for objects named in response to examiner's pointing); 1 for use of one or more verbs, other than parts of the verb be; and 1 for any logical interpretation of the picture. By "interpretation" is meant any attempt to explain the action shown in the picture by reference to some causative factor not actually shown. As a rule, it involves the use of the word because, either expressed or clearly implied. The total possible score is 6 points for each picture, or 18 points for the series of 3 pictures.

Limits of testing. All three pictures should always be given.

VIII. Knox cube imitation. The material used for this test is similar to that originally devised by Knox, except for a slight difference in size. Four one-inch cubes have been glued to a wooden base 7 inches long, with intervals of one inch between each two cubes. Place this model before the child, and, taking a fifth cube, say, "Now watch carefully, and see if you can do exactly what I do." Then tap the first series of 4 taps at the rate of about one tap per second, being careful to avoid rhythm. Then hand the cube to the child and say, "Now you do it." Repeat for each series, being careful to make sure of the child's attention in each instance. The following lines first devised by Pintner but standardized on different material are to be used. The blocks are numbered from the child's left to his right.

a. 1234
b. 12343
c. 12342
d. 1324
e. 1432
f. 1423
g. 13243
h. 14324
i. 13124

Scoring. Score 1 for each correct imitation. Total possible score is 9.

Limits of testing. Continue until 3 successive lines have been failed.

IX. Obeying simple commands. With child standing near the center of the room, take the ball and throw it to him, saying, "Look! Catch it." When he has it in his hands, say, "Now throw it back to me," extending hands as if to catch it. Full credit is given if child attempts to carry out the command, regardless of whether or not he succeeds in catching the ball.

2. Put a small doll on the table before the child and say, "The dollie wants to sit on the chair. Put her on the chair." Repeat if necessary. Do not illustrate.

3. Place a small cup on the table and say, "Dollie wants a drink. Give her a drink." Do not illustrate.

4. Having previously placed a book on the table on the side farthest away from the child, put a small box within his reach and say, "Now I want you to do an errand for me. Listen carefully so you will know what you have to do. First, I want you to put this little box over there on that chair"--pointing to a chair at the opposite side of the room--"and then bring me that book"--pointing to the book. "Don't forget--first put the box on the chair and then bring me the book. Now go ahead." Directions should be given rather slowly and the significant words, first, then, book, and box, should be emphasized. If the child attempts to carry out the commands before the directions have been completed, restrain him, saying, "Wait a minute, there's something else."

5. Follow the same procedure as in the previous situation. The directions are, "First put the doll on the table, then open [or close] the door, and then bring me the box"--pointing to each as the directions are given. The box is the one which the child previously placed on the chair, and which has been left there until this time. Repeat the directions once before permitting the child to begin.

Scoring. Allow 1 point each for tests 1, 2, and 3. On tests 4 and 5, credit 1 point if directions are carried out but in an incorrect order and 2 points for each if the order is also correct. Total possible score is 7.

Limits of testing. Continue the series until two successive failures have been made.

X. Comprehension. Secure the child's attention, then say:

"What should you do when you are hungry?"
"What should do when you are sleepy?"
"What should you do if you should find that your house is on fire?"

Questions may be repeated if necessary.

Scoring. Credit 1 point for each logical response. Note that children sometimes confuse the words sleepy and sleeping. If response suggests that such a confusion exists, repeat the question, stressing the last syllable. Total possible score is 3.

Limits of testing. All three questions should always be tried.

XI. Discrimination of forms. Place the card for this test before the child with the small circle at the point marked X. Trace the outline of the circle with the finger, saying, "See this round ball? Look all around the card and see if you can find another one just like it." If the first response is incorrect, say, "No, that's not like the one I showed you. Find another one just like this," again tracing the circle with the finger. If he again responds incorrectly, or if he fails to respond at all, point to the circle and say, "See, this is it. These two are just alike," pointing to each in turn. Then replace the circle by the rectangle and say, "Here is something else. See if you can find one just like this." If first response is incorrect, say, "No, that is not the one. Find one just like this," tracing the outline of the figure as before. If the correct response is not given then, point to the rectangle and say, "See, this is the one. It is just like the one I showed you," pointing to each in turn. Then present the remaining stimulus cards in order as numbered, but give no help or suggestions in any of the others.

Scoring. Credit 1 point for each correct response. No credit is given for the first two forms unless the child is able to point them out without help or suggestion, in which case they receive equal credit with the others. If the child spontaneously alters his choice, credit on the basis of the last choice, whether this is right or wrong. Total possible score is 10.

Limits of testing. If the child fails on all of the first three forms, the remaining seven need not be given, but if there are any successes in the first three trials, all the remaining forms should always be tried.

XII. Naming objects from memory. Say to the child, "This is a take-away game." Place a ball and a small doll on the table and have him name each in turn. Then say, "Now wait a minute, and don't look!" Interpose a cardboard screen between the child and the objects and remove the doll. The doll should be small enough so that it can readily be concealed in the examiner's hand as it is withdrawn. Then remove the screen and say to the child, "Now look, what did I take away?" If child hesitates more than a few seconds, say, "What was it that was there a minute ago?"--pointing to the place where doll lay. If the child still fails to respond, or responds incorrectly, show him the doll and say, "Look, it was a doll that I took away"

2. Same procedure as the foregoing, but without correction of errors. Use a pencil and a key; take away the pencil.

3. Same procedure as in test 2. Use a ball, a penny, and a key; take away the penny.

4. Use the small picture cards provided for this test. Lay the horse, the chair, and the apple in a row before the child in the order named. Point to each in turn and say, "What is this?" If he gives an incorrect name, do not correct him, but if he fails to recognize any picture, name it for him. Then say, "Now tell me what they are once more so you won't forget," and have him name each one a second time. After cautioning him not to look, interpose the screen and proceed as in the former tests, taking away the horse.

5. Use pictures of house, man, and cup. Take away the cup. Follow same procedure as in test 4.

6. Use pictures of girl, tree, shoe, bird. Take away the shoe.

7. Use pictures of key, glove, star, scissors. Take away the glove.

8. Use pictures of cat, basket, chicken, fork, wagon. Take away the fork.

9. Use pictures of flower, hat, table, rabbit, boy. Take away the table.

Scoring. Score 1 for each correct response. Full credit is given if the child responds correctly either to the first question, "What did I take away?" or to the second, "What was it that was there?"

If child names one or more of the pictures incorrectly but replies consistently to the questions, e.g., calls the horse a "dog" throughout, full credit is given. Total possible score is 9.

Limits of testing. Continue the series until three successive failures have been made.

XIII. Aesthetic comparison. Show the child the first picture for this test and say, "Look at the two girls. Which is the pretty one? Put your finger on the nice girl." Same procedure for pictures 2 and 3.

Scoring. Credit 1 for each correct response. Total possible score is 3.

Limits of testing. All three pictures should always be tried.

XIV. Recognition of forms. Place the large card used in this test face down on the table before the child and say, "This is a game where we have to find things. I'll show you a picture for just a second like this" (holding up one of the small cards for an instant), "and then I'll turn the big card over and see if you can find one like it among these" (turning over the large card for an instant but not giving child time to examine it). "Are you all ready? Look carefully, then, so you'll be sure to know it when I turn the card over. Look hard, so you won't forget." Immediately after the word ready, the examiner should expose the first of the eight small cards, holding it before the child's eyes while urging him to look carefully. At the end of five seconds, place the small card face downward on the table, turn the large card face up, and say, "Now see if you can find one like the one I showed you. Look carefully at them all so you'll be sure to get it right." Proceed similarly with the remaining forms, showing them in order as numbered. Do not correct errors.

Scoring. Score 1 for each form correctly pointed out. Total possible score is 8.

Limits of testing. If the score on the test of form discrimination (Series XI) was zero, this test need not be tried; otherwise it should always be given. If given, all eight forms should be tried.

XV. Colors. Show the cards for this test in the following order: red, blue, pink, white, and brown. Ask, "What color is this?" or "What do you call this color?"

Scoring. Score 1 for each color named correctly. Total possible score is 5.

Limits of testing. All five colors should always be tried.

XVI. Tracing a form. Place one of the circles before the child and say, "Here's something else for you to make. See this round road? I'm going to see if you can go all the way around without getting off the track. Watch first and see how I do it." Take the pencil and draw around the circle very slowly, taking about twenty seconds to complete the drawing. Then give the child another sheet and say, "Now let's see you do it. Be very careful. Stay on the track all the time." No further illustration need be given for the square or the irregular form. Simply place the sheet before the child and say, "Let's try another one. Be sure not to get off the track."

Scoring. Allow a basal score of 4 for each form. Subtract 1 for each inch or fraction thereof drawn outside the boundary lines. Measurement should be taken on the boundary line crossed. Find the total distance outside the boundary line by adding all the measurements together and count any fraction remaining after the measurements have been totaled as an entire inch. Subtract this result from the basal score of 4. The remainder will be the child's score. No minus credits are given; i.e., the score can never be less than zero, even if the entire line is outside the boundaries. No penalty if the line touches the boundary provided it does not actually cross it. The total possible score for this series is 12 points.

Limits of testing. The series need not be attempted with children whose total score on Series IV and V combined is less than 6 points. Children who make a zero score on both the circle and the square need not be given the irregular form.

XVII. Picture puzzles: rectangular series. Place Picture 1 before the child in the position shown in the diagram. Say, "Here is a picture which has been cut in two. Put the pieces together so they will make the picture right again." Allow one minute.

If child is not able to join the pieces correctly by that time, or if he puts them together incorrectly, examiner should join them correctly for him, saying, "This is the way to do it; you see when we fix them like this, it makes a good picture." Pictures 2, 3, and 4 are given in the same way, being sure that the pieces are always arranged in the position shown. No help should be given after the first picture. The time limit is two minutes for each.

Scoring. Credit 1 point for each cut correctly joined. No credit is given on the first picture unless it is done correctly without help. The total possible score on the four pictures is 1, 1, 4, and 7, or 13 points for the entire series.

Limits of testing. Continue until a zero score has been made on two successive pictures.

XVIII. Incomplete pictures. Say, "Now we are going to play a guessing game. I'll show you a picture which is not finished, and you see whether you can guess what it is going to be." Give the demonstration series (shoe) first. Show the first card, saying, "What do you think this is going to be?" Urge child to guess if he can, but do not insist too strongly if he says he does not know. Whether he guesses correctly or not, say, "Well, let's look at the next one and see if that looks like a ______" (whatever the child has mentioned). Show all five pictures of the shoe in this way, then spread them out before the child, and say, "You see how they go now, don't you? The first picture showed just a little of the shoe; this shows a little more; this one still more; this, more yet; and this one shows the whole shoe. Now I have some more pictures done just the same way and I want to see how well you can guess what they are." Then show first the bird, then the girl, then the watch, in the same way. Allow only one guess at each stage. If the guess is incorrect, say, "Let's look at the next one and see if that looks like a ______." As soon as the child guesses correctly, say, "That's right, it is a _______, see?" exposing the remaining stages rapidly in turn.

Scoring. Disregard the performance on the demonstration series. On each of the three remaining pictures, credit 5 points if the picture is named correctly at the first stage, 4 if named at the second stage, etc. The total possible score is 15 points for the entire series.

Limits of testing. Children who make a zero score on Series II (pointing out objects in pictures) need not be given this series. All three pictures should be tried if the test is given.

XIX. Digit span. "Now I'm going to see how well you can say numbers. Say 'two.' Now say 'eight, six,'" etc. Digits should be presented at a uniform rate of speed, a little faster than one per second. Be careful to avoid rhythm. Examiner should check up on his speed with a stop watch at frequent intervals. As soon as success is achieved at any difficulty level, pass on at once to the next more difficult series, and allow not more than three trials at each level. Do not repeat any group of figures a second time except that the first digit tried may be repeated a sufficient number of times to get the the child started. Young or negativistic children often do better with this test if given a doll or other toy to hold while the numbers are being repeated.

Scoring. Credit as many points for the entire series as there are digits in the most difficult group repeated correctly. Order of digits must also be correct. Total possible score is 7.

Limits of testing. Continue until a level has been reached where three out of three trials are failed.

Digit Series

a. 2 - 9 - 6
b. 86 -37 -49
c. 642 -379 -518
d. 4136-7359-8621
e. 72516 -83971 -94613
f. 241936 -728419 -837524
g. 9482617-8549316-5791368

XX. Picture puzzles; diagonal series. Say, "Now we have some more cut-up pictures. Let's see if you can put this one together." Proceed similarly with the remaining three pictures in turn. Do not correct errors or illustrate procedure. Be sure that the pieces are presented in the position shown in the diagrams.

Scoring. Credit 1 point for each cut correctly joined. The total possible score is 13.

Limits of testing. Children who make a zero score on the rectangular series (XVII) need not be given this series. If test is given, continue until a zero score has been made on two successive series.

XXI. Definitions. Say, "What is a fork? Tell me what a fork is." If child hesitates, say, "You know what a fork is, don't you? You see a fork every day at the table. Now tell me, what is a fork?" Then ask, "What is a horse? What is a balloon? What is a soldier? What is a tiger?"

Scoring. Credit 1 on each item for any fact other than simply repeating the stimulus word, but without naming genus. This includes use, color, material, attempt at description, etc. Examples: "A fork is to eat with." "A horse has four feet." "A balloon is rubber," etc. Credit 2 on each item for "thing" as a genus with additional qualifying phrase, as "A thing you eat with" or for a more precise genus without qualifying phrase, as "A horse is an animal." Credit 3 on each item for precise genus with qualifying phrase, as "A horse is an animal that draws wagons." Total possible score is 15.

Limits of testing. The test should be tried with all children whose speech has advanced to a level where as many as five or six words are combined in a single sentence. All five items should always be given.

XXII. Paper folding.

a. Take one of the six-inch squares of paper and say, "I am going to fold this piece of paper. Then I will give you another piece and see if you can fold it just the way I did. Watch carefully so you will know how." Then fold the left edge of the paper onto the right edge, then the bottom edges onto the top edges, then the lower left corner onto the upper right corner, making a triangle. Then say, "Now you make one just like it," giving him a second piece. Put your folded piece on the table before him where he can see it as he folds, using a weight to hold down the corners.

b. Then say, "Now let's try another one." Taking a fresh piece of paper, fold the lower left corner onto the upper right corner, making a triangle. Then fold the lower corner onto the upper right corner. Then fold the corner on the left onto the upper right corner, making a square. Have child copy as before.

c. Say, "Now we are going to make just one more." Take a fresh sheet of paper, and with a pencil make a cross at the center. Fold the upper right corner onto this cross. Then fold the lower left corner to the cross at the center. Then fold the lower side onto the upper side so that what was the right half of the lower edge will now continue the left half of the upper edge in a straight line, making a perfect rectangle. Then fold the upper left corner onto the middle of the lower edge of the rectangle. Then fold the corner on the left onto the lower right corner making a square. Give the child the second piece of paper, and say, "Now you make one just like this." If child's attention wanders during any part of the test, say, "Watch me carefully, so you'll know how."

Scoring. Credit 1 point for each fold correctly made regardless of order of folding. Subtract 1 for each incorrect or additional fold, but give no score lower than zero. The total possible score is 3, 3, and 5, or 11 for the series.

Limits of testing. Children who make a zero score on both series of picture puzzles need not be given this test. If the score on both a and b is zero, c need not be tried.

XXIII. Absurdities. Say, "Now I am going to tell you a story that is nonsense--a foolish story. Listen carefully and see if you can tell me what is foolish about it." Then read the sentences rather slowly in the order given. After each one, ask, "What is foolish about that?"

a. Fred ate tin cans for his breakfast.
b. Yesterday I saw a cat with two tails.

c. Red ink makes a black mark.
d. John is a tall girl.
e. Bobbie forgot to put on his shoes when he went outdoors and so his hands got cold.
f. An engineer said that the more cars he had on his train the faster it would go.
g. There was a railroad accident the other day, but it was not very serious. Only forty-eight people were killed.

Scoring. Score 1 for each correct response. A response is counted as correct if it clearly indicates that the child has seen the absurdity. In doubtful cases ask, "I'm not sure what you mean. Tell me just what it is that is foolish." Total possible score is 7.

Limits of testing. If the score on the comprehension questions (Series X) is zero, this test need not be tried. Continue testing until three successive failures have been made.

XXIV. Mutilated pictures. Show the fore-exercise card first. Say, "There is something the matter with this woman's face. Something is left out. Look carefully and see if you can tell me what is not there." If child does not respond, or responds incorrectly, point to the place where the eye should be, and say, "See, the eye is gone." Then show the remaining cards in order as numbered, but give no help. Simply say in each case, "What is gone from this one?" or "What is the matter with this____?"

Scoring. Credit 1 for each correct reply, disregarding fore-exercise. Total possible score is 5.

Limits of testing. Test need not be given to children whose score on Series II (response to pictures) is less than 6 points. If given, all 5 pictures should be tried.

XXV. Vocabulary test. The words used are the first 25 in the first list of the Stanford Vocabulary Test. Say to the child, "I want to see how many words you know. Listen, and when I say a word, you tell me what it means. Gown, what does that mean? What is a gown?" If child hesitates, urge him, saying, "I think you can tell me. You have seen gowns, haven't you? Then tell me, what is a gown?" Proceed similarly with the remaining words

Scoring. (See pages 224-31 of The Measurement of Intelligence.) The general rules to be followed are these: Full credit is given for any definition which shows unmistakably that the child knows the meaning of the word. *The form of the definition is* entirely disregarded. Using the word in a sentence which clearly illustrates the meaning scores full credit. Half credit is given for definitions based upon slang terms, as "Copper is a policeman," "Nerve means you've got your nerve," etc. Score 1 for each word correctly defined. The total possible score is 25.

Limits of testing. Children who make a zero score on the definitions test (Series XXI) need not be given this test. Continue testing until six successive words have been failed.

XXVI. Comprehension of directions. Give the child a sheet of the blank squares used for this test and a pencil. Point with your pencil to the first square and say, "See this square? This is the center of the square. What is it? This is the upper right corner of the square. What is it?" Have him repeat, and correct him if he repeats wrongly. Using the same square, proceed in the same way for the lower left corner, the middle of the left side, the middle of the lower side, and again for the center. Then give the following: "Draw a straight line from the center of the square [pointing to the center with your pencil] to

a. "The upper left corner.
b. "The middle of the left side.
c. "The lower right corner.
d. "The middle of the upper side."

Speak slowly and repeat the direction once if necessary. If the first trial is failed, draw the line correctly for him and explain, but give no help on the remaining three.

Scoring. Credit 1 point for each line correctly drawn without help. The total score possible is 4.

Limits of testing. Children who make a score of less than four points on the test of obeying directions (Series IX) need not be given this test. If the first two trials are failed, the remaining two need not be tried.

XXVII. Giving word opposites. Say: "I am going to give you a word, and see if you can tell me another word that means just the opposite. For example, if I were to say to you 'black,' you must say 'white.' If I were to say 'no,' you must say 'yes.' If I say 'rich,' you must say 'poor,' and so on. Now let us see if you know it. What do you say when I say 'black'?" Repeat for no and rich, giving him the correct word if he fails. Then give him the list of ten words, correcting any errors made on the first three.

1. Cold
2. Bad
3. Short
4. Thick
5. Dry
6. Pretty
7. Sweet
8. Dark
9. Sick
10. Asleep

Scoring. Credit 1 for each correct opposite given without help. The total possible score is 10.

Limits of testing. The test need not be given to children who make a zero score on the definitions test (Series XXI). If the first five words are all failed, the remaining five need not be tried.

XXVIII. Imitating position of clock hands. Show the cardboard clock with the hands set at 3:45. Say, "Look at the clock. It holds its hands out like this to show us what time it is. Let's see you put your hands just like the clock has its hands." If child hesitates, illustrate, holding the arms at right angles to the body, saying, "See, this is the way. I have my hands just like the clock's hands." Then set the hands at each of the following hours in turn, but give no further help:

a. 8:10
b. 1:50
c. 12:00
d. 1:10

Scoring. Credit 1 for each successful performance, disregarding the illustration. Record whether the imitation is a mirror image or a true copy, but give credit to either. Credit the angle as correct if both hands are in the proper quadrant. Total possible score is 4.

Limits of testing. Children whose score on the test of following directions (Series IX) is less than four points need not be given this test. If the first two trials are failed, the last two need not be tried.

XXIX. Speech. This is to be scored on the basis of casual observation during the giving of the entire scale. A sample sentence of the level upon which the scoring is based should be recorded in the appropriate place on the record blank. The sentence recorded may be a response to a test or may have been given in incidental conversation. The examiner should keep this speech-test in mind throughout the examination, or until at least one sentence of five or more words has been recorded.

Scoring. The score is given for any one response which is at the highest level, even though the majority of the child's remarks have been at a lower level. Score 1 for sentences of from two to four words. Score 2 for sentences of five or more words. The above scores are noncumulative. The highest possible score is 2 points and this is given only for the type of response named above.

Directions for Administering the Minnesota Preschool Scale

FORM B

I. Pointing out parts of the body. Show child the small doll. Let him handle it a moment, then say, "Show me dollie's mouth. Put your finger on her mouth." If child does not respond, ask, "Has dollie any mouth? Look, find the mouth for me." Same for arms, hair, feet, knee.

Scoring. Credit 1 for each feature correctly pointed out. If child points first to one feature, then to another, score on the basis of final choice, whether right or wrong. Total possible score is 5.

Limits of testing. The complete series should always be tried.

II. Pointing out objects in pictures. Say, "Now I have some pictures to show you." Show card B, II. Say, "Where is the dog? Put your finger on the dog." (The word "bow-wow" may be substituted if child recognizes that term more readily.) Repeat and urge if necessary. If child does not respond, take his hand and put it on the dog, saying, "See, there is the dog. Now show me the doll." Urging is permitted, but no further help may be given after the first picture. Continue in same manner with shoe, tree, bird, cup. If pointing is not clear, say, "Which do you mean? Put your finger right on the____."

Scoring. Score 1 for each picture correctly pointed out without help. If a spontaneous correction is made, score on the basis of the second choice in all cases, whether right or wrong. Total possible score is 6.

Limits of testing. The complete series should always be tried.

III. Naming familiar objects. Show child the doll, and say, "What is this?" Repeat and urge if necessary. Continue with key, penny, book, spoon.

Scoring. Score 1 for each correct response, disregarding articulation. Infantile expressions such as "bookie" for book are given full credit. "Money," "cent," or "cents" for penny are given full credit. The total possible score is 5.

Limits of testing. The entire series should always be tried.

IV. Copying drawings. Place the card with the vertical cross before the child, together with pencil and paper. Say, "Let me see you make a picture just like this." Point to cross but be careful not to trace outline with finger. When child has finished, say, "That is fine. Now make another one." Allow three trials is all. Follow same procedure with the square and the six-pointed star.

Scoring. Credit 1 for each successful performance with each of the three forms. The cross is credited if two lines which cross each other at any angle are drawn, regardless of length of lines or of symmetry. The square is credited if there are four sides separated by four approximate right angles (no rounded corners) and if the ratio of the width to the height or vice versa is not greater than 2 to 1. Wavy lines due to poor motor coordination are not penalized, provided the angles are clear. The star is credited regardless of whether it is drawn as two triangles or whether the child copies first the outline of the star and then fills in the hexagon, provided the proper number of points are drawn. See scoring card for illustrations of successes and failures with each of the three figures. The total possible score is 9.

Limits of testing. Continue until a figure is reached for which all three trials are failed.

V. Imitative drawing. Place paper and pencil before the child, and say, "Now watch and see what I am going to make." Take the pencil and make a vertical scribble about two inches long, repeating the movement three or four times in each direction. Then hand the pencil to the child and say, "You make one like that." Urge if necessary. If no satisfactory response can be elicited, repeat illustration several times, or until it is obvious that the child cannot perform the task. Manual guidance is not permitted. Repeat the procedure using a horizontal scribble, and again with a right angle, made without lifting the pencil and in the form of the letter L.

Scoring. Credit is given for the vertical scribble if the child makes a rubbing movement with the pencil of any length and regardless of direction. The horizontal scribble is credited only if drawn in an approximately horizontal direction, and if the preceding vertical scribble was performed vertically so that the two are clearly differentiated. Length of line is disregarded. Any angle is given credit for the right angle. A credit of 2 points is given for each figure if the child imitates successfully after a single illustration. If more than one illustration is required, the score is 1. Total possible score is 6.

Limits of testing. If the score on the test of copying drawings (Series IV) is three or more, full credit of 6 points is allowed for this series without actually giving the tests. If the score on Series IV is less than 3 points, this series should always be given. Both the vertical and the horizontal scribbles should always be tried, but if these are failed, the angle need not be attempted.

VI. Block building. Place 6 one-inch cubes before the child, and say, "Now we are going to build something." With 3 of the cubes build a chair, while the child looks on. Then push the other 3 cubes toward him and say, "Now you make a chair like that." If he succeeds in copying the model, take 6 more cubes and say, "This time we'll make stairs." The model should be left so that the child can see it as he builds. Give only one illustration for each model and allow one additional trial (but only one) if the first structure falls down before completion. Do not correct errors.

Scoring. Allow 1 point for each model successfully completed. If the upper blocks are not placed directly over the lower ones, credit is to be allowed provided the space on one side is at least double that on the other. Total possible score is 2.

Limits of testing. If the first model is failed, the second need not be attempted.

VII. Response to pictures. Place the first picture (the doll's bath) before the child and say, "Tell me what this picture is about. What is this a picture of?" Repeat three times if need be. If child names one or two objects and then stops, urge him to continue, saying, "Go ahead. Tell me all you can." Proceed in a similar fashion with pictures 2 and 3. Always present pictures in the same order.

Scoring. On each picture, score 1 for each different object named up to a total of 3. Allow 1 additional point for the use of 1 or more prepositions; 1 for use of 1 or more verbs other than parts of the verb be; and 1 for any logical interpretation of the picture. By "interpretation" is meant any attempt to explain the action shown in the picture by reference to some causative factor not actually shown. As a rule, it involves the use of the word because expressed or clearly implied. The total possible score is 6 points for each picture, or 18 points for the series of 3 pictures.

Limits of testing. All three pictures should always be given.

VIII. Knox cube imitation. The material used for this test is similar to that originally devised by Knox except for a slight difference in size. Four one-inch cubes have been fastened to a wooden base 7 inches long with intervals of one inch between each two cubes. Place this model before the child and, taking a fifth cube, say, "Now watch me carefully and see if you can do exactly as I do." Then tap the first series of 4 taps at the rate of about one tap per second, being careful to avoid rhythm. Then hand the cube to the child and say, "Now you do it." Repeat for each series, being careful to make sure of the child's attention in each instance. The following lines reversed from a series devised by Pintner but standardized on different material are to be used. The blocks are numbered from the child's left to his right.

a. 4321
b. 43212
c. 43213
d. 4231
e. 4123
f. 4132
g. 42312
h. 41231
i. 42431

Scoring. Score 1 for each correct imitation. Total possible score is 9.

Limits of testing. Continue until 3 successive lines have been failed.

IX. *Obeying simple commands*. With child standing near the center of the room, take the ball and throw it a few feet away from him, saying, "Look! Get the ball and throw it back to me," extending hands as if to catch it.

2. When the child has the ball in his hands, say, "Now put the ball on the table and then we'll see some more things." Repeat if necessary. Do not illustrate.

3. Put the doll, together with a small square of cloth, on the table and say, "Here is a handkerchief for dollie. Take the handkerchief and wipe the dollie's nose." Do not illustrate.

4. Having previously placed a small box on a chair at the opposite side of the room, and a book on the side of the table farthest away from the child, put a pencil within his reach and say, "Now I want you to do an errand for me. Listen carefully, so you will know what it is you have to do. First, I want you to put this pencil over there in that box," pointing, "and then bring me that book," pointing to the book. "Don't forget, first put the pencil in the box, and then bring me the book. Now go ahead." Directions should be given rather slowly, and the significant words, *first*, *then*, *pencil*, *box*, and *book*, should be emphasized. If the child attempts to carry out the commands before the directions have been completed, restrain him, saying, "Wait a minute, there's something else."

5. Follow the same procedure as in the previous situation. The directions are, "First put the book on the chair, then open the door, and then bring me the pencil" (pointing to each as the directions are given). The pencil is the one which the child previously placed in the box, and which has been left there until this time. Repeat the directions once before permitting the child to begin.

Scoring. Allow 1 point each for tests 1, 2, 3. On tests 4 and 5, credit 2 points for each if the directions are carried out in the correct order and 1 point if all directions are followed but the order is incorrect.

Limits of testing. Continue the series until two successive failures have been made.

X. *Comprehension*. Secure the child's attention, then say:

"What should you do when you are cold?"
"What should you do when you are thirsty?"
"What should you do if you are going someplace and miss the trolley car?"

Questions may be repeated if necessary.

Scoring. Credit 1 point for each logical response. If the child's response to the first question indicates that he is confusing the meaning with *having a cold*, say, "No, I don't mean when you *have* a cold. What should you do when you *are* cold [or when you feel cold]?" If this does not serve to make the distinction clear, the score is zero. The total possible score for the three questions is 3.

XI. *Discrimination of forms*. Place the card for this test before the child, with the ellipse at the point marked X. Trace the outline of the ellipse with the finger, saying, "See the egg? Look all around the card and find another egg, just like this one." If the first response is incorrect, say, "No, that's not like the one I showed you. Find another one just like this," again tracing the ellipse with the finger. If he again responds incorrectly, or if he fails to respond at all, point to the second ellipse and say, "See, here it is. These two are just alike," pointing to each in turn. Then replace the ellipse by the square and say, "Here is something else. See if you can find one just like this." If first response is incorrect, say, "No, that is not the one. Find one just like this," tracing the outline of the figure as before. If the correct response is not then given, point to the second square and say, "See, this is the one. It is just like the one I showed you," pointing to each in turn. Then present the remaining stimulus cards in order as numbered, but give no further help or suggestions on any of the others.

Scoring. Credit 1 for each correct response. No credit is given for the first two forms unless the child is able to point them out without help or suggestion, in which case they receive equal credit with the others. If the child spontaneously alters his choice, credit on the basis of the last choice whether this is right or wrong. The total possible score is 10.

Limits of testing. If the child fails on all of the first three forms, the remaining seven need not be given, but if there are any successes in the first three trials, all the remaining forms should always be tried.

XII. Naming objects from memory. Say to the child, "This is a take-away game." Place a ball and a small doll on the table and have him name each in turn. Then say, "Now wait a minute, and don't look!" Interpose a cardboard screen between the child and the objects and remove the ball. This should be small enough so that it can readily be concealed in the examiner's hand as it is withdrawn. Then remove the screen and say to the child, "Now look. What did I take away?" If child hesitates more than a few seconds, say, "What was it that was there a minute ago?" pointing to the place where the ball lay. If child still fails to respond, or responds incorrectly, show him the ball and say, "Look, it was a ball that I took away."

2. Same procedure as the foregoing, but without correction of errors. Use a pencil and a key; take away the key.

3. Same procedure as in test 2. Use a doll, a pencil, and a ball; take away the pencil.

4. Use the small picture cards provided for this test. Lay the tree, the apple, and the horse in a row before the child, in the order named. Point to each in turn, and say, "What is this?" If he gives an incorrect name, do not correct him, but if he fails to recognize a picture, name it for him. Then say, "Now tell me what they are once more so you won't forget." and have him name each one a second time. After cautioning him not to look, interpose the screen and proceed as in the former tests, taking away the tree.

5. Use pictures of flower, girl, bird; take away the bird.

6. Use pictures of chair, house, man, and key; take away the man.

7. Use pictures of cup, scissors, shoe, glove; take away the scissors.

8. Use pictures of fork, wagon, boy, basket, chicken; take away the basket.

9. Use pictures of table, star, cat, hat, rabbit; take away the cat.

Scoring. Score 1 for each correct response. Full credit is allowed if child responds correctly either to the first question, "What did I take away?" or to the second, "What was it that was there?" If child names one or more of the pictures incorrectly but replies consistently to the questions, e.g., calls the bird a "chicken" throughout, full credit is given. The total possible score is 9.

Limits of testing. Continue the series until three successive failures have been made.

XIII. Aesthetic comparison. Show the child the first picture for this test and say, "Look at the two_____. Which is the pretty one? Put your finger on the nice_____." Same procedure for pictures 2 and 3.

Scoring. Credit 1 for each correct response. The total possible score is 3.

Limits of testing. All three pictures should always be tried.

XIV. Recognition of forms. Place the large card used in this test face down on the table before the child and say, "This is a game where we have to find things. I'll show you a picture for just a second like this"[holding up one of the small cards for an instant], "and then I'll turn over the big card and see if you can find one like it among these," turning over the large card for an instant but not giving child time to examine it. "Are you all ready? Look carefully, then, so you'll be sure to know it when I turn the card over. Look hard so you won't forget it." Immediately after the word ready, the examiner should expose the first of the eight small cards, holding it before the child's eyes while urging him to look carefully. At the end of five seconds, place the small card face downward on the table, turn the large card face up, and say, "Now see if you can find one like the one I showed you. Look carefully at them all so you will be sure to get it right." Proceed similarly with the other forms, showing them in order as numbered. Do not correct errors.

Scoring. Score 1 for each form correctly pointed out. The total possible score is 8.

Limits of testing. If the score on the test of form discrimination was zero, this test need not be tried; otherwise it should always be given. If given, all eight forms should always be tried.

XV. Colors. Show the cards for this test in the following order: yellow, orange, green, black, purple. Ask, "What color is this?" or "What do you call this color?"

Scoring. Score 1 for each color correctly named. Total possible score is 5.

Limits of testing. All five colors should always be tried.

XVI. Tracing a form. Place one of the ellipses before the child and say, "Here's something else for you to make. See this round road? I'm going to see if you can go all the way around without getting off the track. Watch first and see how I do it." Take the pencil and draw around the ellipse very slowly, taking about twenty seconds to complete the drawing. Then give the child another sheet and say, "Now, let's see you do it. Be very careful. Stay on the track all the time." No further illustration need be given for the square or the irregular form. Simply place the sheet before the child and say, "Let's try another one. Be sure not to get off the track."

Scoring. Allow a basal score of 4 for each form. Subtract 1 for each inch or fraction thereof drawn outside the boundary line. Measurements should be taken on the boundary line crossed. Find the total distance outside the boundary line by adding all the measurements together, and count any fraction remaining after the measurements have been totaled as an entire inch. Subtract this result from the basal score of 4. The remainder will be the child's score. No minus credits are given; i.e., the score can never be less than zero, even if the entire line is outside the boundaries. If the line merely touches the boundary without actually crossing, the child is not penalized. The total possible score for this series is 12 points.

Limits of testing. The series need not be attempted with children whose total score on Series IV and V is less than 6 points. Children who make a zero score on both the ellipse and the diamond need not be given the Maltese cross.

XVII. Picture puzzles: rectangular series. Place Picture 1 before the child in the position shown in the diagram. Say, "Here is a picture which has been cut in two. Put the pieces together so they will make the picture right again." Allow one minute. If child is not able to put it together correctly by that time, or if he has joined them incorrectly, the examiner should join them correctly for him, saying, "This is the way to do it. You see, when we fix them like this, it makes a good picture."

Pictures 2, 3, and 4 are given in the same way, being sure that the pieces are always arranged in the order shown. No help should be given after the first picture. The time limit is 2 minutes for each.

Scoring. Credit 1 point for each cut correctly joined. No credit is given on the first picture unless it is done correctly without help. The total possible score on the four pictures is 1, 1, 4, and 7, or 13 points for the entire series.

Limits of testing. Continue until a zero score has been made on two successive pictures.

XVIII. Incomplete pictures. Say, "Now we are going to play a guessing game. I'll show you a picture which is not finished, and you see whether you can guess what it is going to be." Give the demonstration series (shoe) first. Show the first card, saying, "What do you think this is going to be?" Urge child to guess if he can, but do not insist too strongly if he says he does not know. Whether he guesses correctly or not, say, "Well, let's look at the next one and see if that looks like a ____" (whatever the child has mentioned). Show all five pictures of the shoe in this way, then spread them out before the child, saying, "You see how they go now, don't you? The first picture showed just a little of the shoe, this one shows a little more, this one still more, the next more yet, and this one shows the whole shoe. Now I have some more pictures done just the same way, and I want to see how well you can guess what they are." Then show first the dog, then the automobile, then the chair, in the same way. Allow only one guess at each stage. If the guess is incorrect, say, "Let's look at the next one and see if that looks like a _____." As soon as the child guesses correctly, say, "That's right, it is a _____, see?" exposing the remaining stages rapidly in turn.

Scoring. Disregard the performance on the demonstration series. On each of the three remaining pictures, credit 5 points if the picture is named correctly at the first stage, 4 if named at the second stage, etc. The total possible score for the three pictures is 15 points.

Limits of testing. Children who make a zero score on Series II (pointing out objects in pictures) need not be given this test. If the test is given, all three pictures should be tried.

XIX. Digit span. Say, "Now, I'm going to see how well you can say numbers. Say 'four.' Now say 'five, nine,'" etc. Digits should be presented at a uniform rate of speed, a little faster than one per second. Be careful to avoid rhythm. Examiner should check up on his speed with a stop watch at frequent intervals. As soon as success is achieved at any difficulty level, pass on at once to the next more difficult series. Allow not more than three trials at each level. Do not repeat any group of figures a second time, except that the first digit tried may be repeated a sufficient number of times to get the child started. Young or negativistic children often do better with this test if given a doll or other toy to hold while the numbers are being repeated.

Scoring. Credit as many points for the entire series as there are digits in the most difficult group repeated correctly. The order must also be correct. The total possible score is 7.

Limits of testing. Continue until a level has been reached at which all three trials are failed.

a. 4 -8 - 3
b. 59 -64 - 73
c. 825 -916 -314
d. 4279-6813-5926
e. 82471 -91358 -65247
f. 928417 -653241 -739468
g. 2864137-5926473-4815927

XX. Picture puzzles: diagonal series. Say, "Now we have some more cut-up pictures. Let's see if you can put this one together." Proceed similarly with the remaining three pictures in turn. Do not correct errors or illustrate procedure. Be sure that the pieces are presented in the position shown in the diagrams.

Scoring. Credit 1 point for each cut correctly joined. Total possible score is 13.

Limits of testing. Children who make a zero score on the rectangular series need not be given this series. If test is given, continue until a zero score has been made on two successive series.

XXI. Definitions. Say, "What is a knife? Tell me what a knife is." If child hesitates, say, "You know what a knife is, don't you? You see one every day at the table. Now tell me, what is a knife?" Then ask, "What is a chicken? What is an automobile? What is a barber? What is a lion?"

Scoring. Credit 1 on each item for any fact other than simply repeating the stimulus word, but without naming genus. This includes use, color, material, attempt at description, etc. Examples: "A knife is to cut with." "A chicken walks." "Automobile has wheels," etc. Credit 2 on each item for thing as genus with additional qualifying phrase, as "A knife is a thing you cut with," or for a more precise genus without qualifying phrase, as "A lion is an animal." Credit 3 on each item for a precise genus with qualifying phrase, as "A barber is a man that cuts hair." The total possible score is 15.

Limits of testing. The test should be tried with all children whose speech has advanced to a level where as many as five or six words are combined in a single sentence. All five items should always be given.

XXII. Paper folding. Take one of the six-inch squares of paper and say, "I am going to fold this piece of paper. Then I will give you another piece and see if you can fold it just the way I did. Watch carefully, so you will know how." Then fold the bottom edge of the paper onto the top edge, then the bottom fold onto the top edge, then the left edge onto the right edge, making a rectangle. Then say, "Now you make one just like it," giving him a second piece. Put your folded piece on the table before him where he can see it as he folds, using a weight to hold down the corners.

b. Then say, "Now we will try another one." Taking a fresh piece of paper, fold the lower left corner onto the right upper corner; then fold the upper right corner of the upper sheet only back onto the center of the opposite side. Then fold the corner on the left onto the lower corner, making a right-angled triangle. Have child copy as before.

c. Say, "Now we are going to make just one more." Take a fresh sheet of paper and with your pencil make a cross at the center. Then fold the upper right corner onto this cross. Then fold the lower edge onto the center, so that the right half of this edge will meet the edge of the part folded first. Then fold the upper left corner onto the cross at the center as in the first folding. Then fold the left edge onto the right edge. Then fold the corner at the top onto the lower left corner, making a rectangular piece with a truncated upper corner. Give the child the second piece of paper and say, "Now you make one just like this."

Scoring. Credit 1 point for each fold correctly made, regardless of order of folding. Subtract 1 for each incorrect or additional fold, but give no score lower than zero. The total possible score is 3, 3, and 5, or 11 for the series.

Limits of testing. Children who make a zero score on both series of picture puzzles need not be given this test. If the score on both a and b is zero, c need not be tried.

XXIII. Absurdities. Say, "Now I am going to tell a story that is nonsense--a foolish story. Listen carefully and see if you can tell me what is foolish about it." Then read the sentences rather slowly in the order given. After each one ask, "What is foolish about that?"

a. Mary's cat is bigger than an elephant.
b. The dog has bright eyes in his tail.
c. Boys wear ribbons on their hair.
d. Yesterday I saw a chicken with three legs.
e. Mary put her finger on the hot stove and it made her stomach ache.
f. A man said, "I know a road from my house to the

city which is downhill all the way to the city and downhill all the way back home."

g. A bicycle rider, being thrown from his bicycle in an accident, struck his head against a stone and was instantly killed. They picked him up and carried him to the hospital, and they do not think he will get well again.

Scoring. Score 1 for each correct response. A response is counted as correct if it clearly indicates that the child has seen the absurdity. In doubtful cases, say; "I'm not sure what you mean. Tell me just what it is that is foolish." The total possible score is 7.

Limits of testing. If the score on the comprehension questions (Series X) is zero, this test need not be tried. Continue testing until three successive failures have been made.

XXIV. Mutilated pictures: Show the fore-exercise first. Say, "There is something the matter with this woman's face. Something is left out. Look carefully and see if you can tell me what is not there." If child does not respond, or if he responds incorrectly, point to the place where the eye should be and say, "See, the eye is gone." Then show the remaining cards in order as numbered, but give no further help. Simply say in each case, "What is gone from this one?" or "What is the matter with this ______?"

Scoring. Credit 1 point for each correct reply, disregarding the fore-exercise. The total possible score is 5.

Limits of testing. The test need not be given to children whose score on Series VII (response to pictures) was less than 6 points. If given, all five pictures should be tried.

XXV. Vocabulary test. The words used are the first 25 in the second list of the Stanford-Binet vocabulary test. Say to the child, "I want to see how many words you know. Listen, and when I say a word, you tell me what it means. Orange, what does that mean? What is an orange?" Proceed similarly with the remaining words.

Scoring. (See pages 224-31 of The Measurement of Intelligence.) The general rules to be followed are these: Full credit is given for any definition which shows unmistakably that the child knows the meaning of the word. The form of the definition is entirely disregarded. Using a word in a sentence which clearly illustrates its meaning is given full credit. Half credit is given for definitions based upon slang terms, as "A copper is a policeman," etc. Score 1 for each word correctly defined. The total possible score is 25.

Limits of testing. Children who make a zero score on the definitions test (Series XXI) need not be given this test. Continue testing until 6 consecutive words have been failed.

XXVI. Comprehension of directions. Give the child a sheet of the blank squares used for this test and a pencil. Point with your finger to the first square, and say, "See this square? This is the center of the square. What is it?" Have him repeat, and correct him if he repeats wrongly. Using the same square, proceed in the same way for the lower left corner, the middle of the left side, the middle of the lower side, and again for the center. Then give the following:
"Draw a straight line from the center of the square [pointing to the center with your pencil] to

a. "The upper right corner.
b. "The middle of the right side.
c. "The lower left corner.
d. "The middle of the lower side."

Speak slowly and repeat the direction once if necessary. If the first trial is failed, draw the line correctly for him and explain, but give no help on the remaining three.

Scoring. Credit 1 point for each line correctly drawn without help. The total possible score is 4.

Limits of testing. Children who make a score of less than 4 points on the test of obeying directions (Series IX) need not be given this test. If the first two trials are failed, the remaining two need not be given.

XXVII. Giving word opposites. Say, "I am going to give you a word, and see if you can give me another word that means just the opposite. For example, if I were to say to you 'black,' you would say 'white.' If I say 'no,' you must say 'yes.' If I say 'rich,' you must say 'poor,' and so on. Now let us see if you know how. What do you say when I say 'black'?" Repeat for no and rich, giving him the correct word if he fails. Then give him the list of ten words, correcting any errors made on the first three.

1. little
2. up
3. slow
4. soft
5. in
6. dirty
7. heavy
8. rough
9. dead
10. open

Scoring. Credit 1 for each correct response given without help. The total possible score is 10.

Limits of testing. The test need not be given to children who make a zero score on the definitions test (Series XXI). If the first five words are all failed, the remaining five need not be given.

XXVIII. Imitating position of clock hands. Show the cardboard clock with the hands set at 3:45. Say, "Look at the clock. It holds its hands out like this to show us what time it is. Let's see you put your hands just like the clock has its hands." If the child hesitates, demonstrate by holding your arms at right angles to your body, saying, "See, this is the way. I have my hands just like the clock's hands." Then set the hands at each of the following hours in turn, but give no further help.

a. 10:20 b. 4:40 c. 6:30 d. 10:45

Scoring. Disregarding the fore-exercise, credit the child 1 point for each successful performance, whether he uses his entire arms or only his hands. Give credit for either a mirror image or a true copy. Credit the angle as correct if each hand is in the proper quadrant. Total possible score on this test is 4 points.

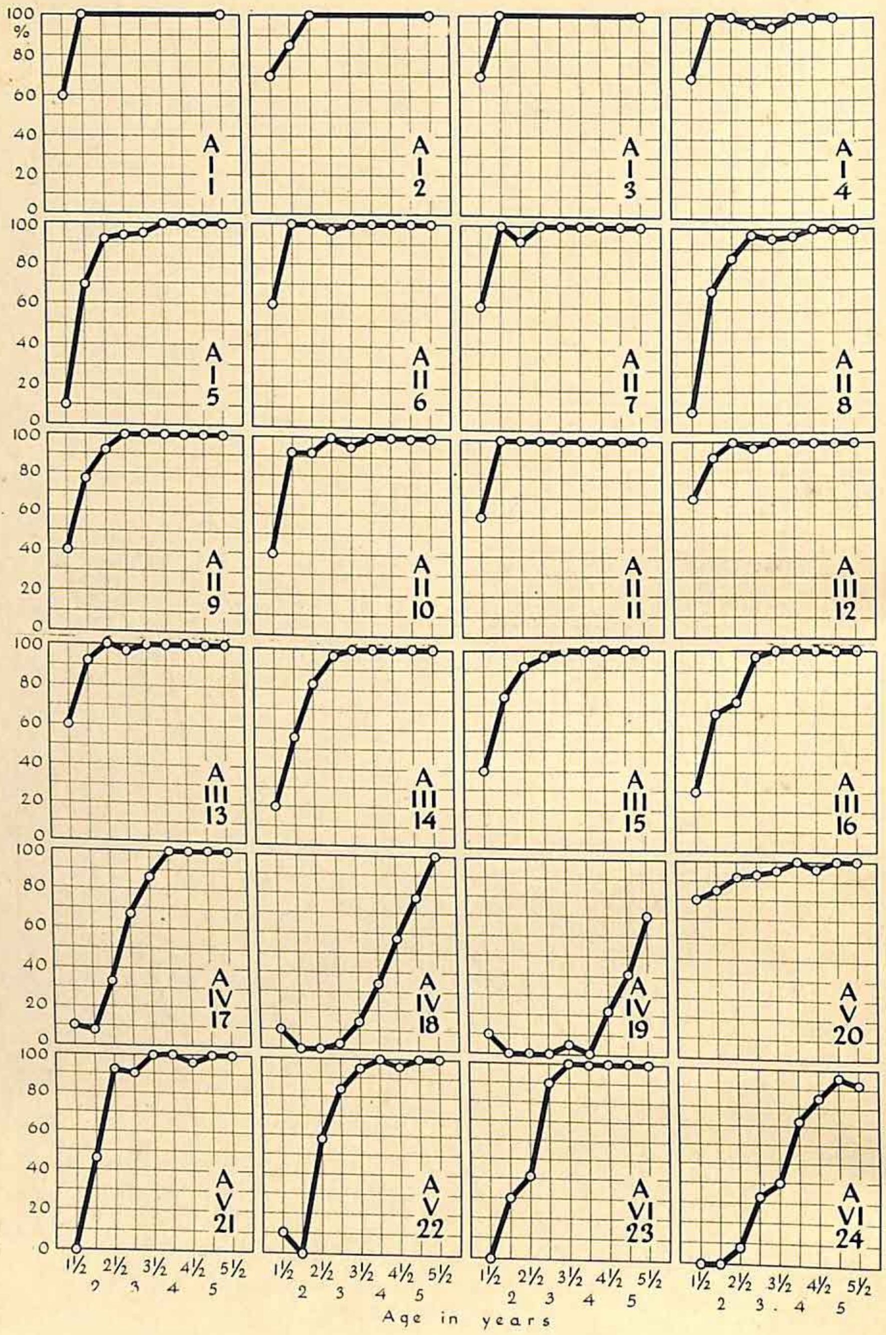
Limits of testing. If this test is given and the first two parts are failed, the last two need not be given.

XXIX. Speech. This is to be scored on the basis of casual observation during the giving of the entire scale. A sample sentence of the level upon which the scoring is based should be recorded in the appropriate place on the record blank. The sentence recorded may be a response to a test or may have been given in incidental conversation. The examiner should keep this speech-test in mind throughout the examination, or until at least one sentence of five or more words has been recorded.

Scoring. The score is given for any one response which is at the highest level, even though the majority of the child's remarks have been at a lower level. Score 1 for sentences of from two to four words. Score 2 for sentences of five or more words. The above scores are noncumulative. The highest possible score is 2 points and this is given only for the type of reponse named above.

APPENDIX C

Graphs Showing the Percentage of Subjects (N=180) Passing Each Item of the Minnesota Preschool Scale, Forms A and B, at Each of Nine Age Levels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A II 11
A III 12
A III 13
A III 14
A III 15
A III 16
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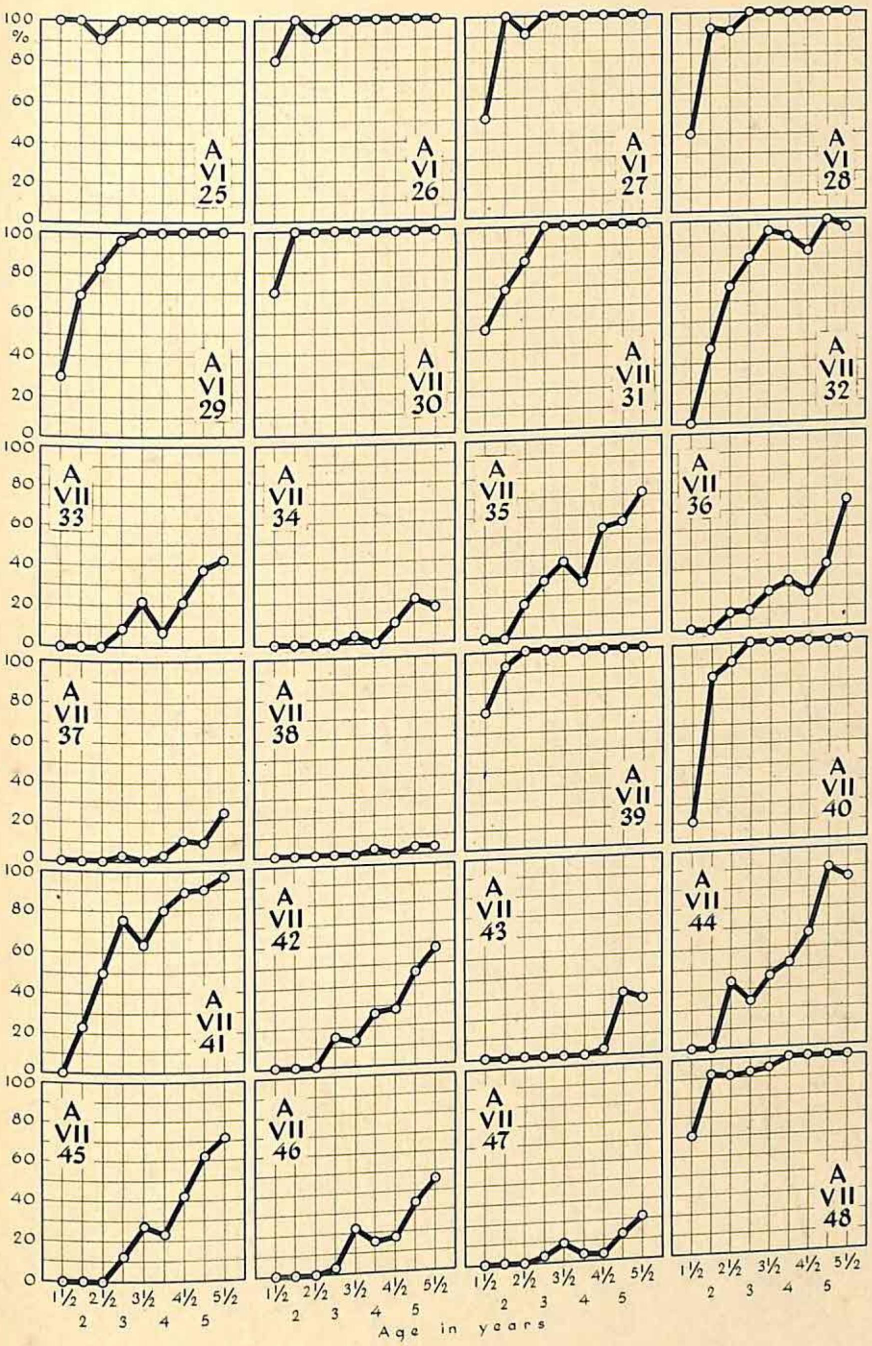
Age in years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A VII 36
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A VII 40
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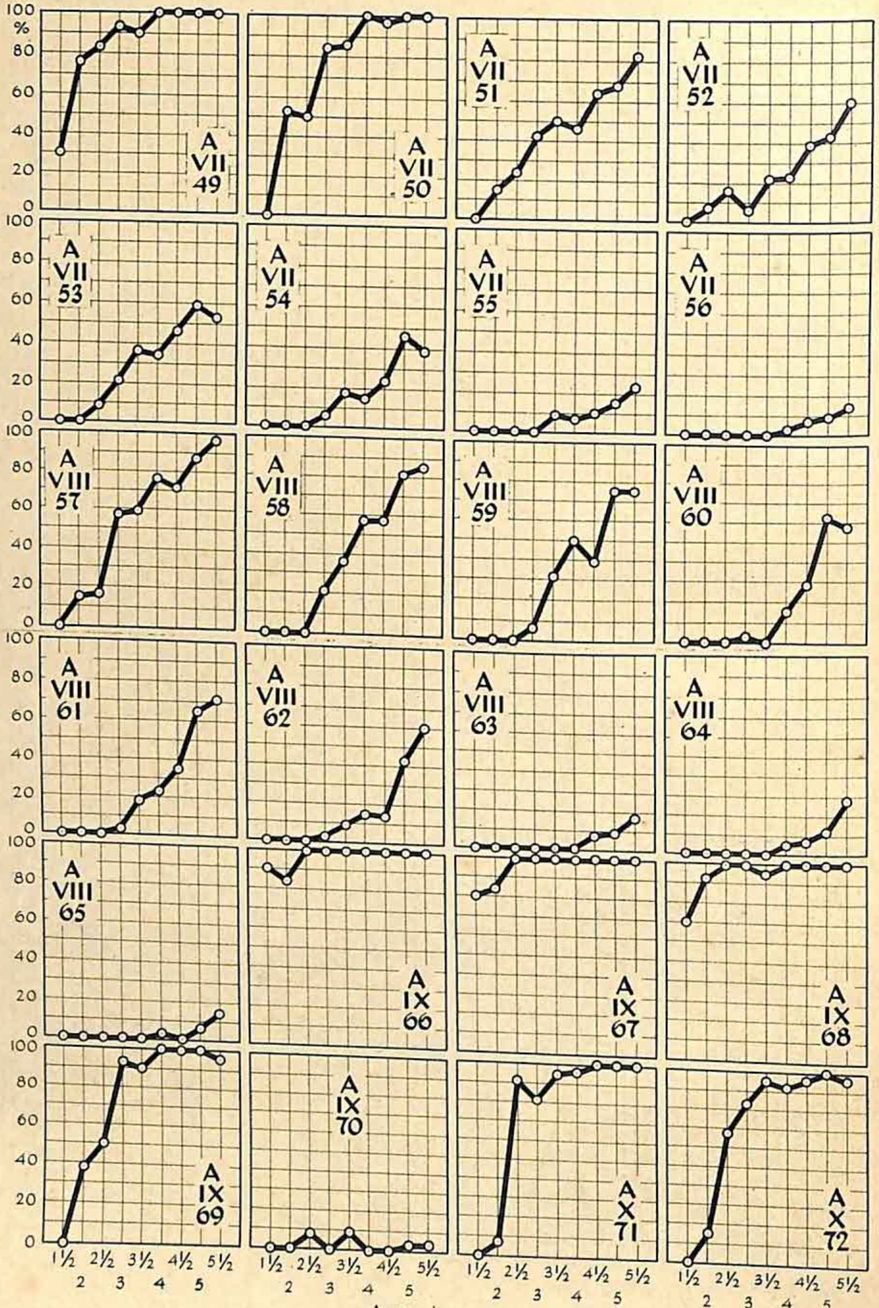
2 3 4 5
Age in years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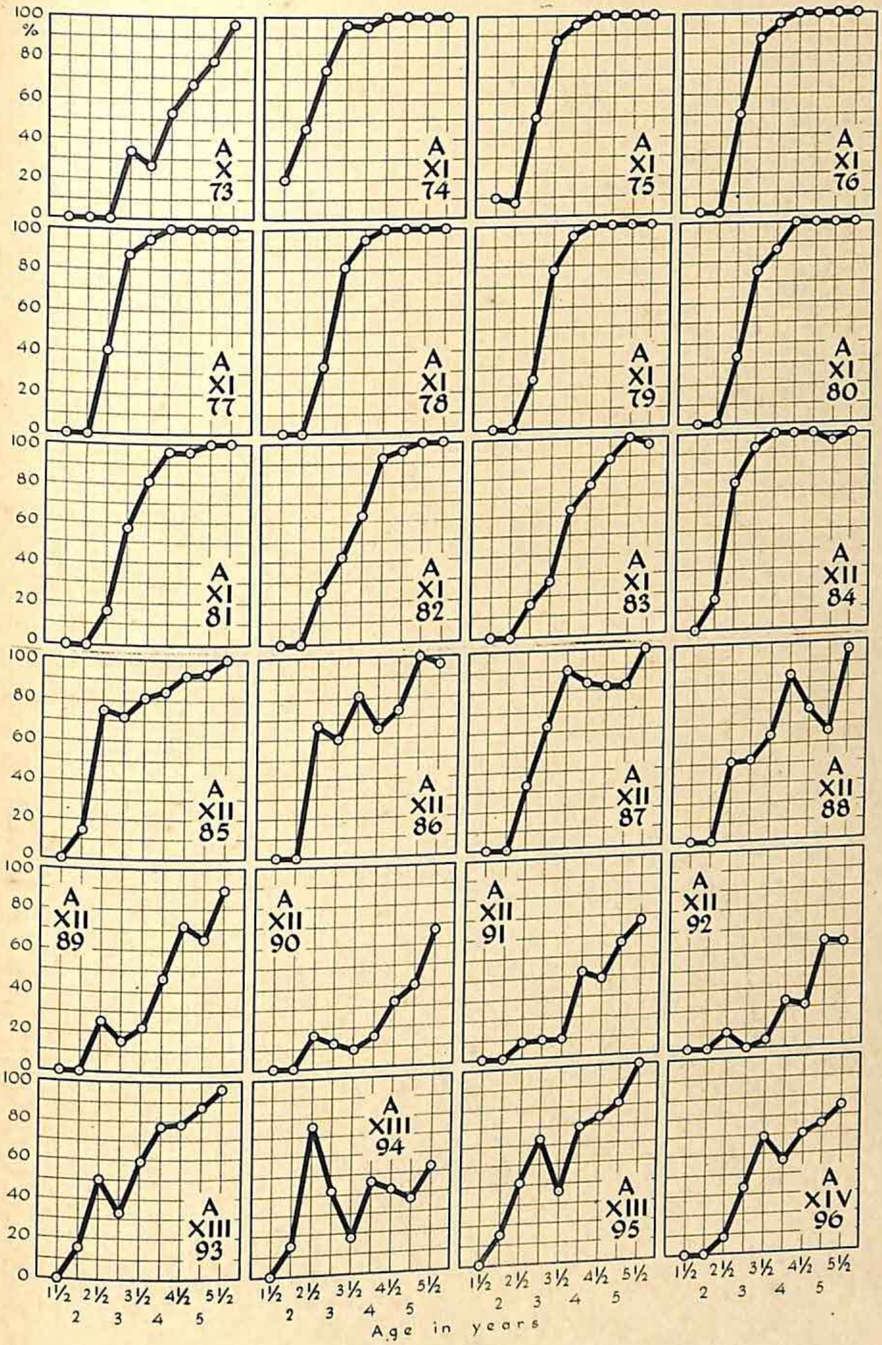
Age in years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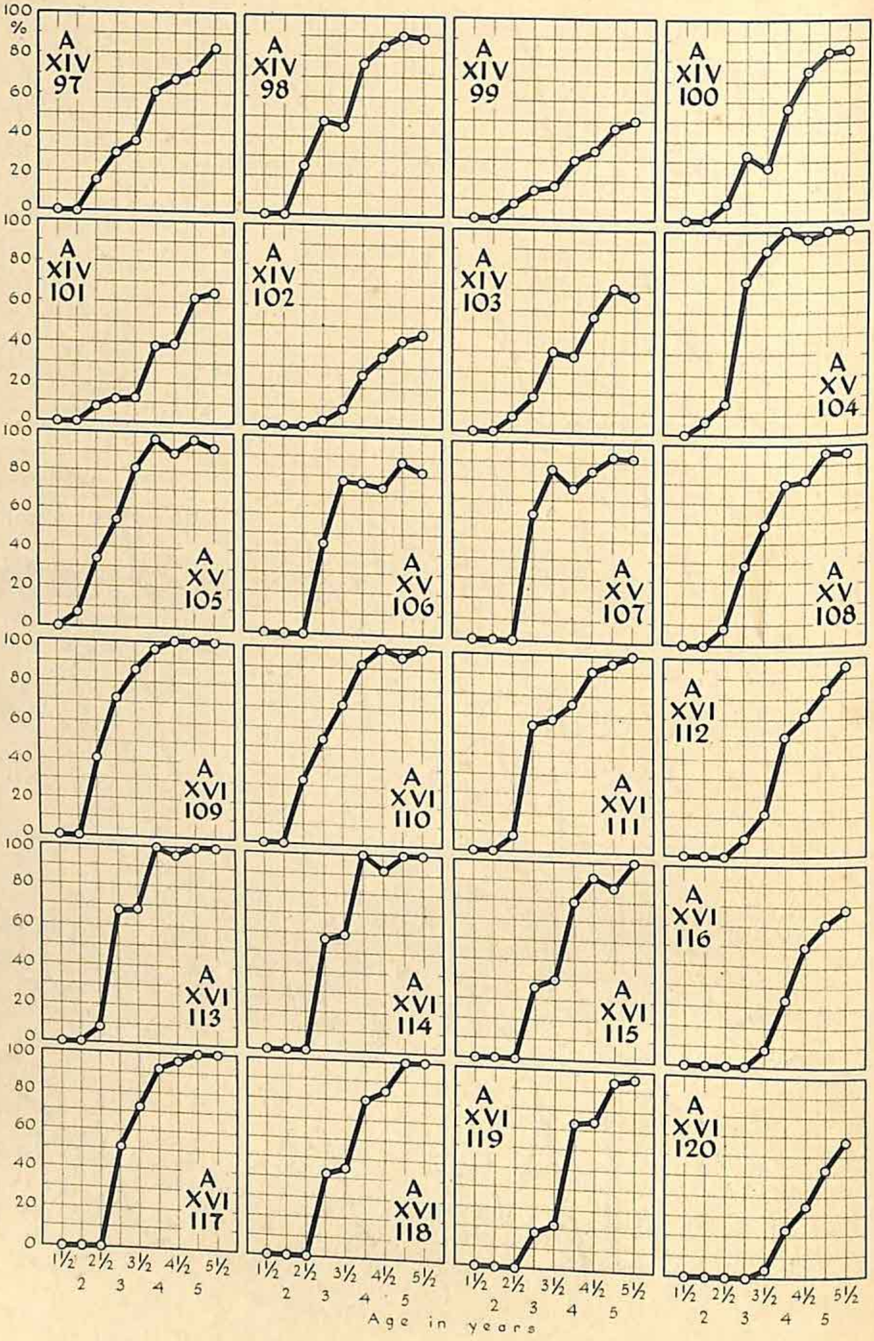
Age in years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A XVI 114
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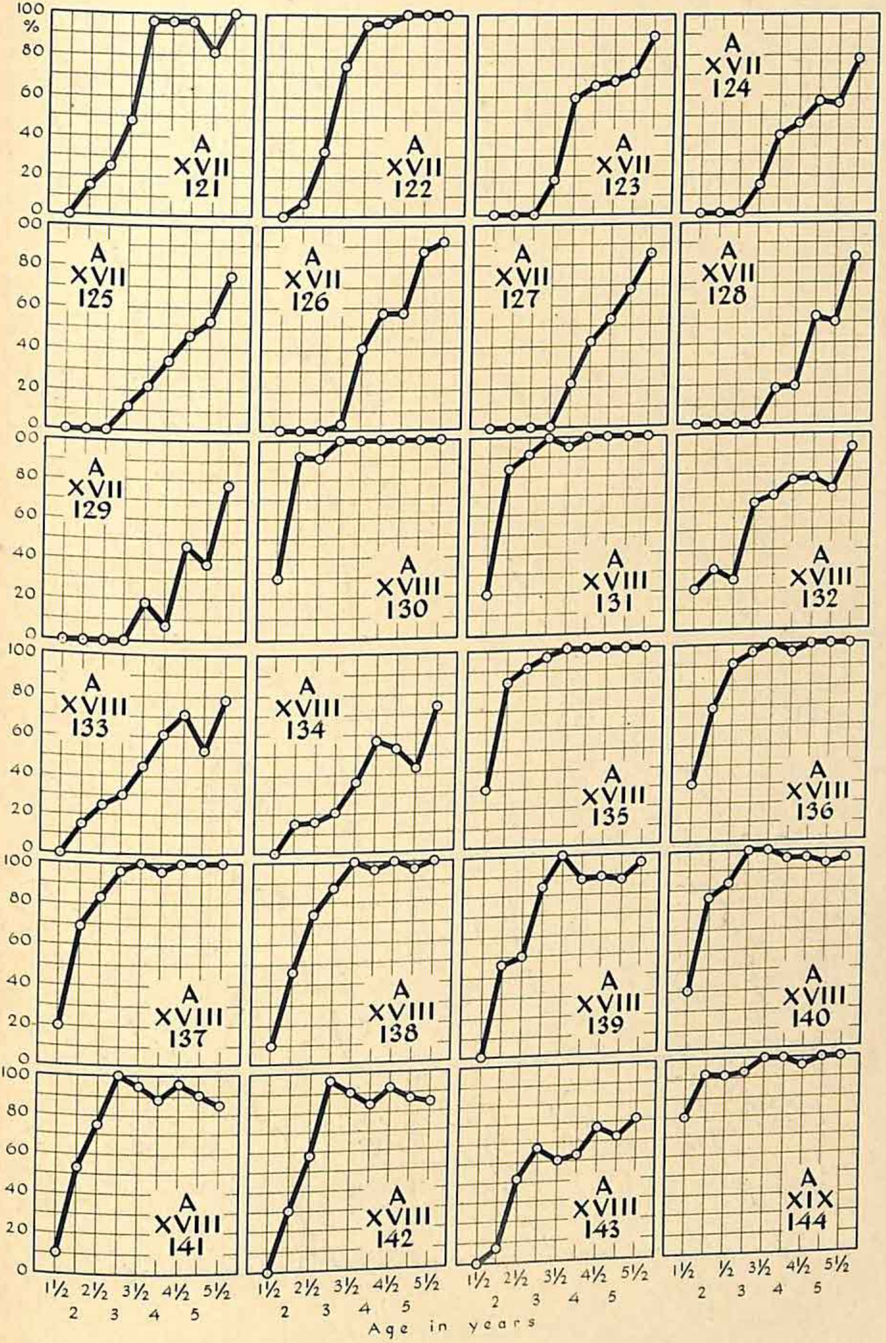
2 3 4 5
Age in years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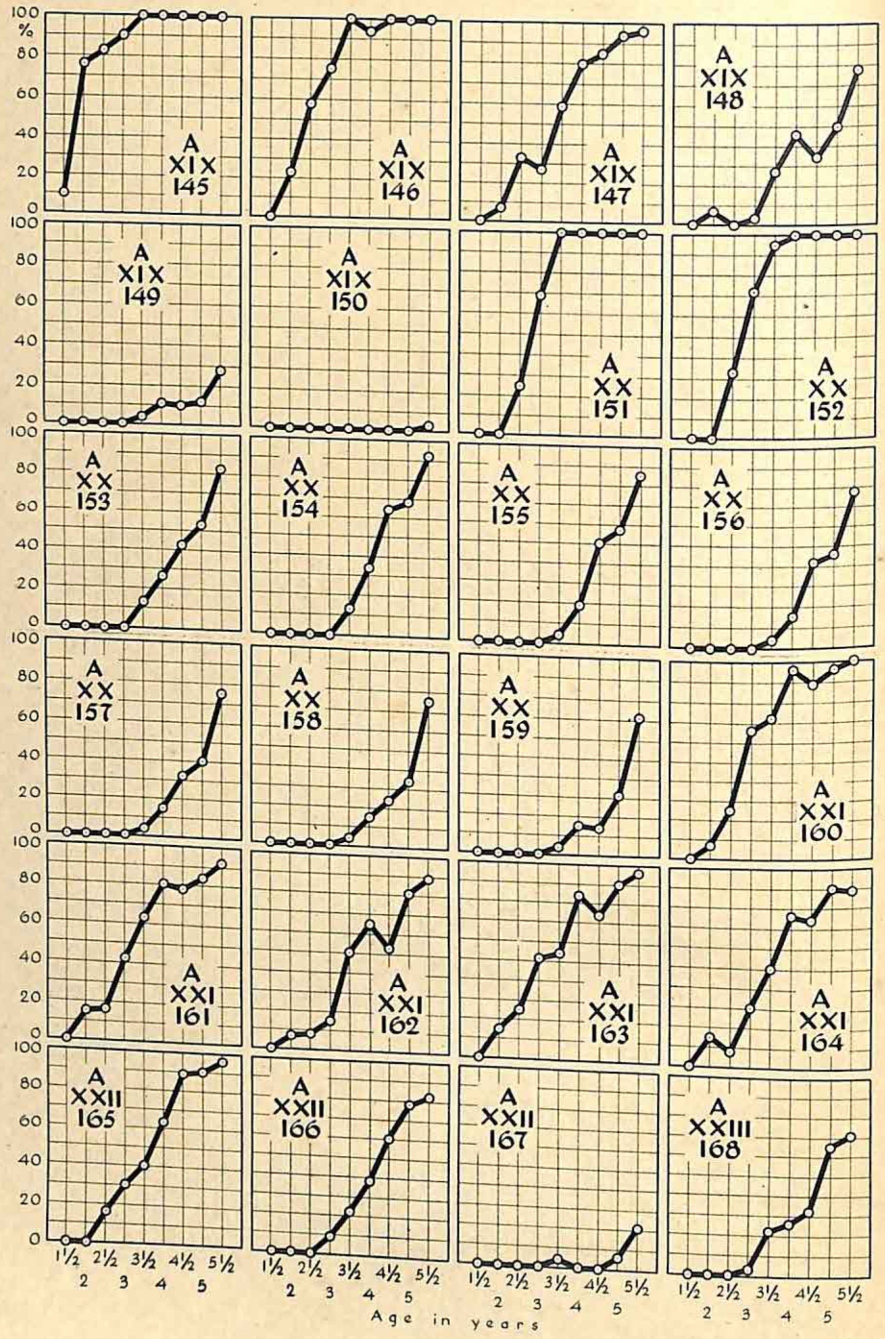
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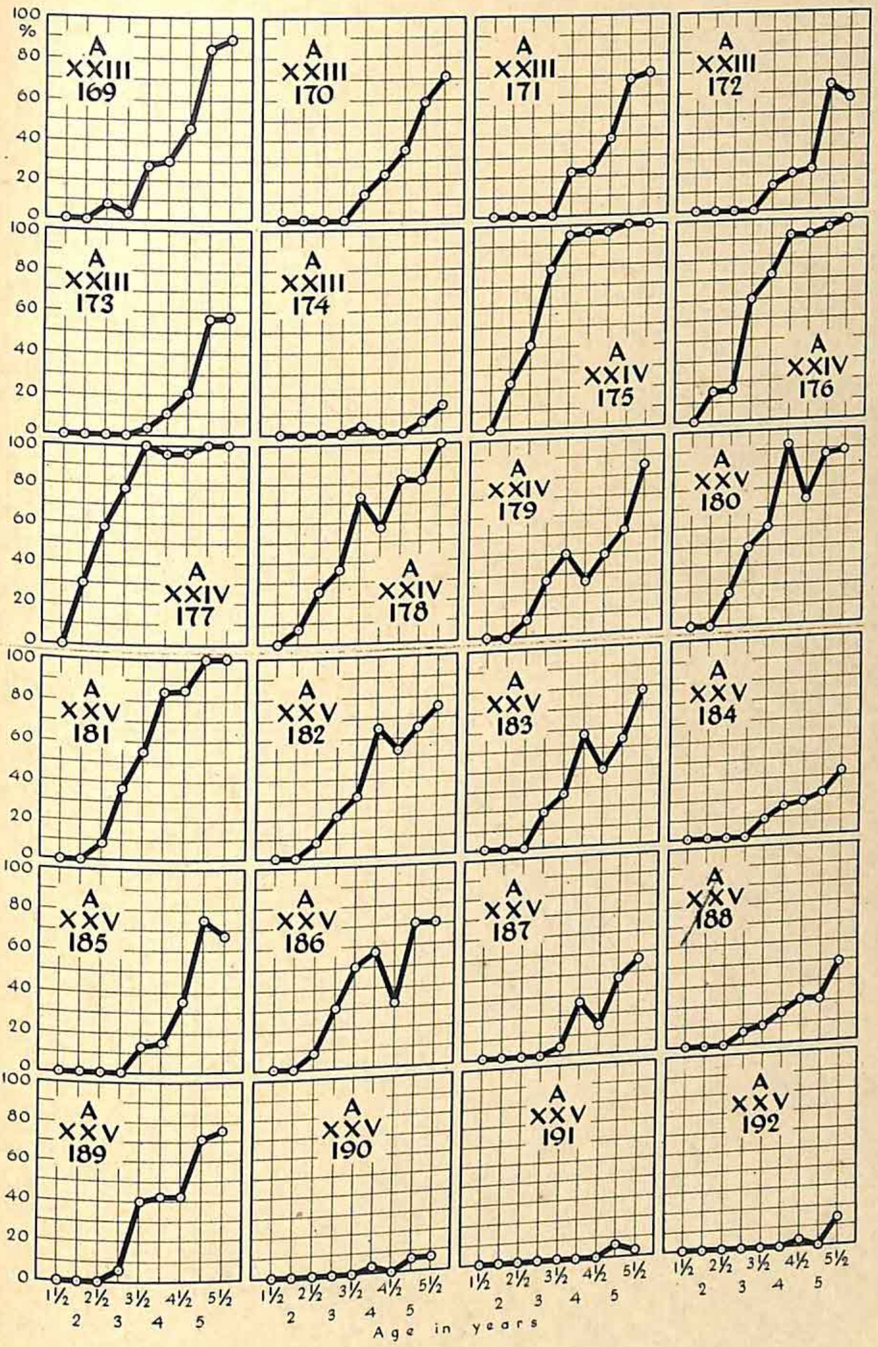
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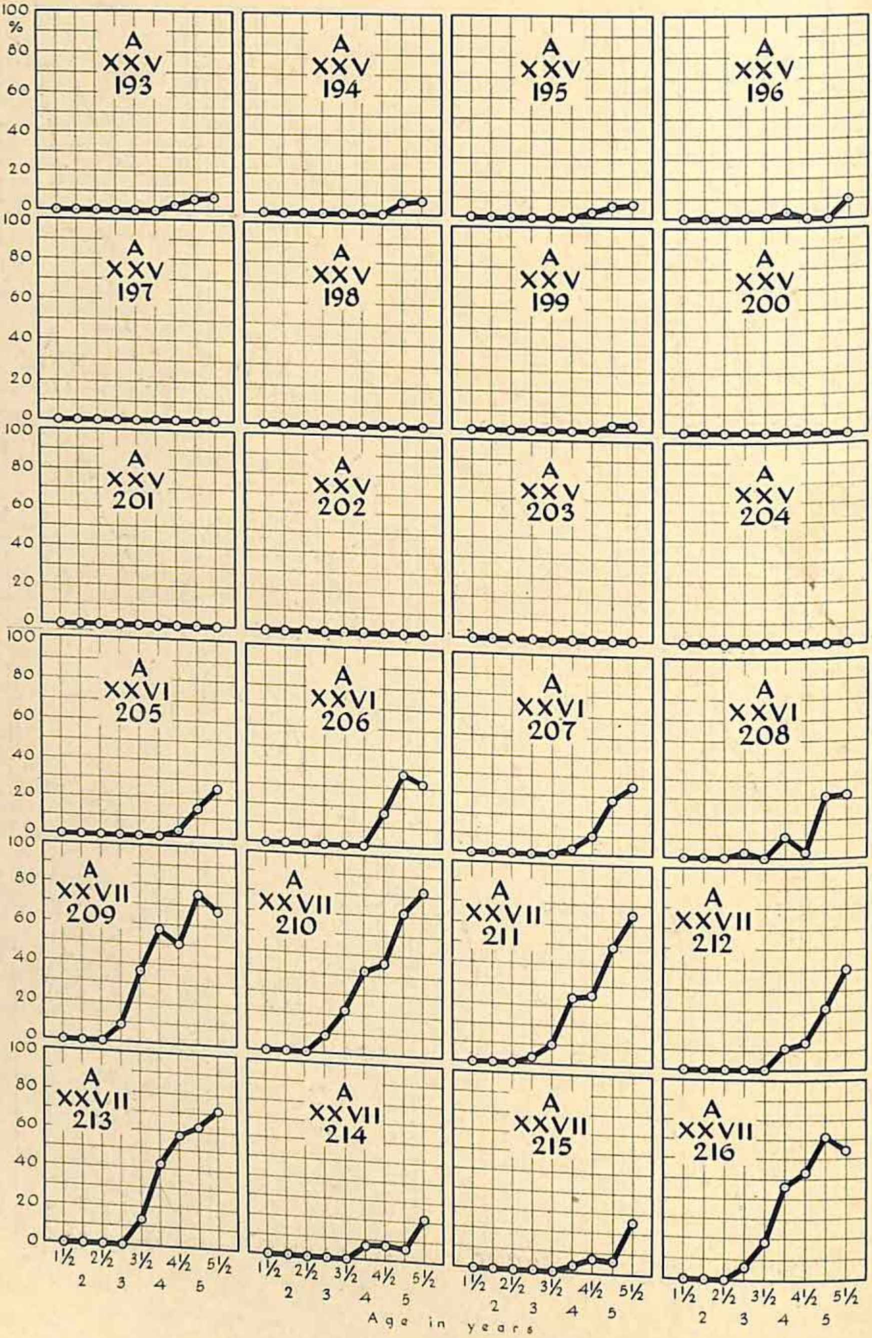
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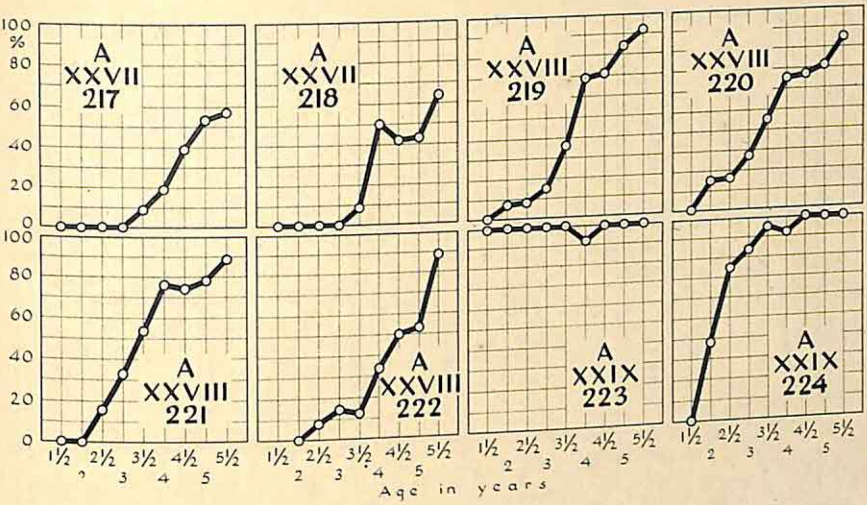
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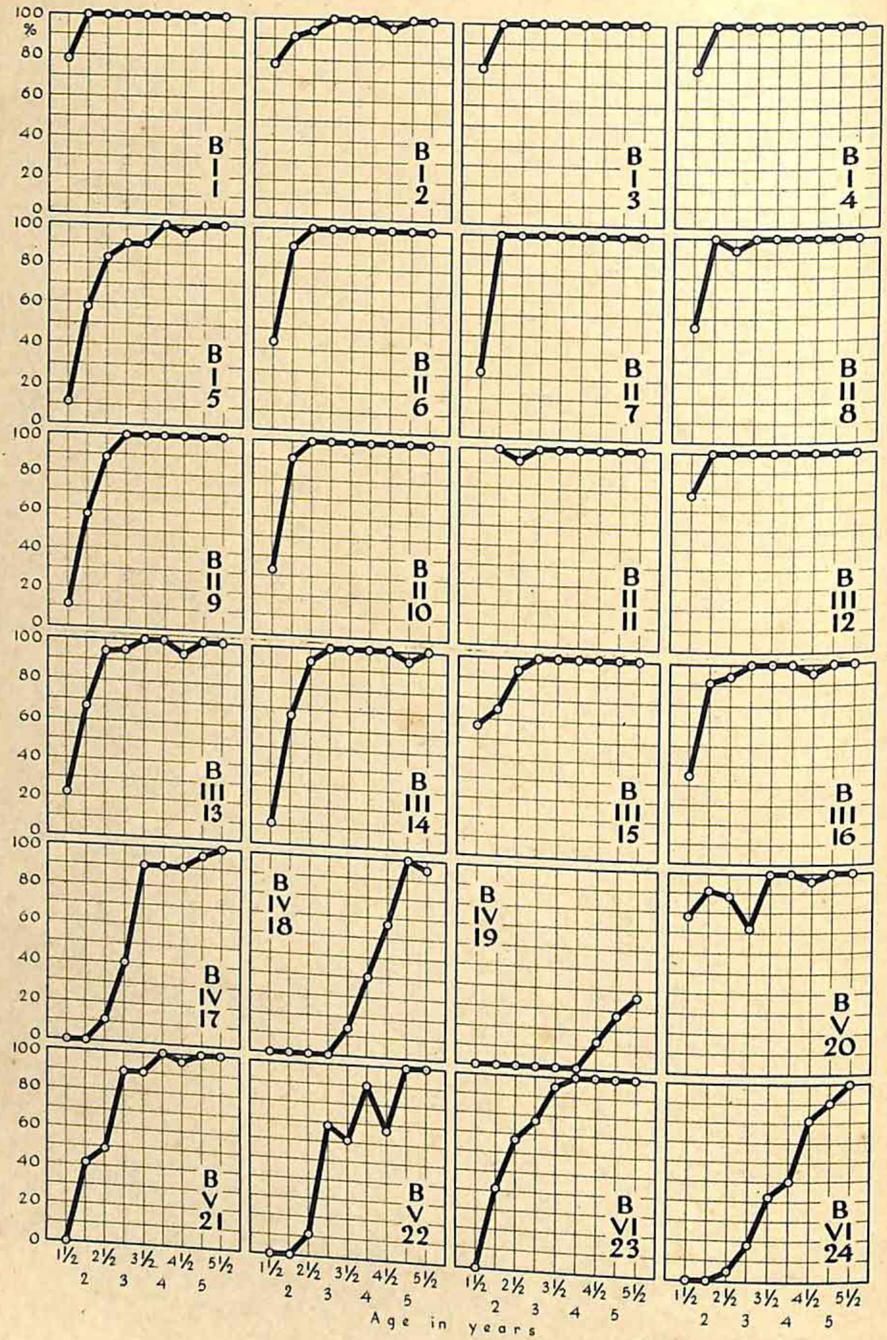

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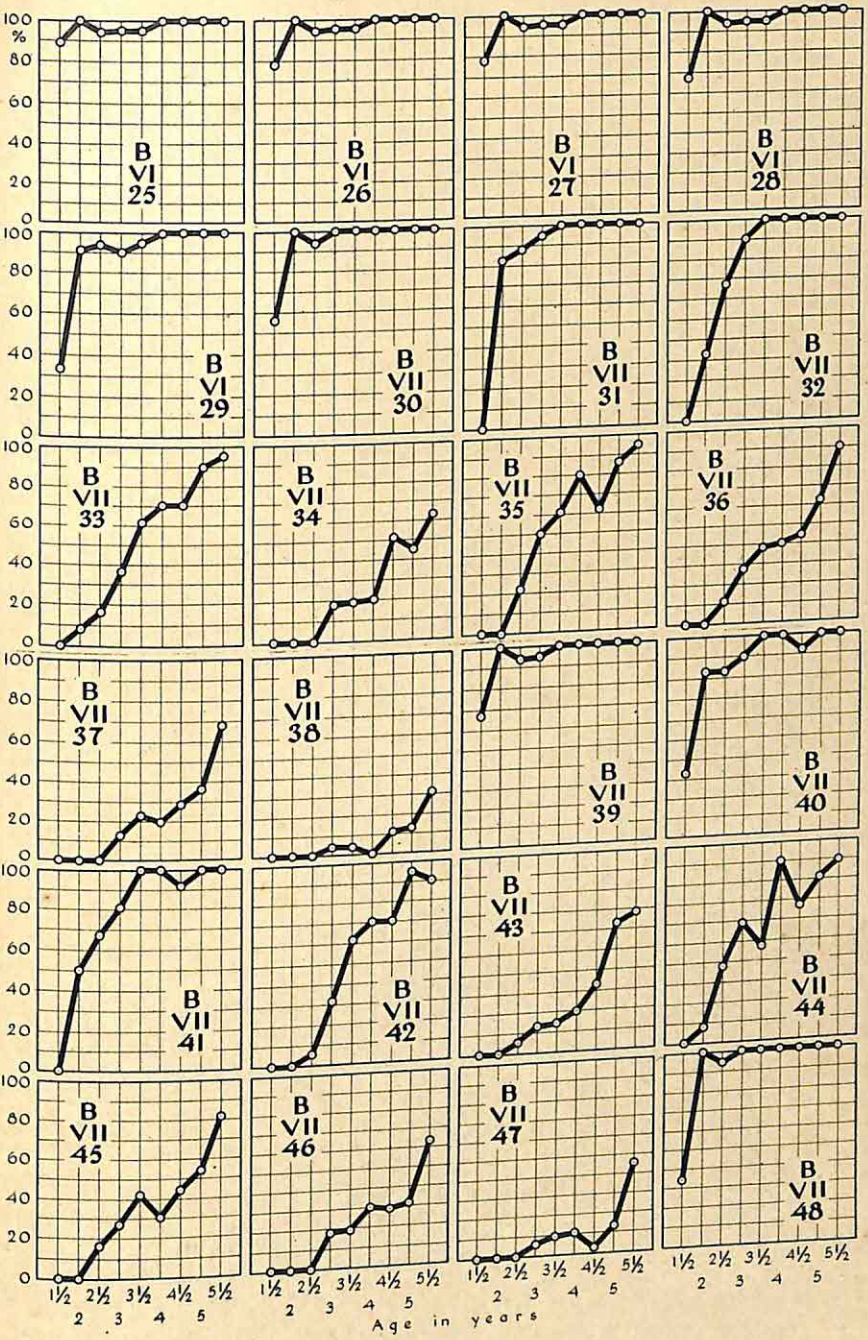
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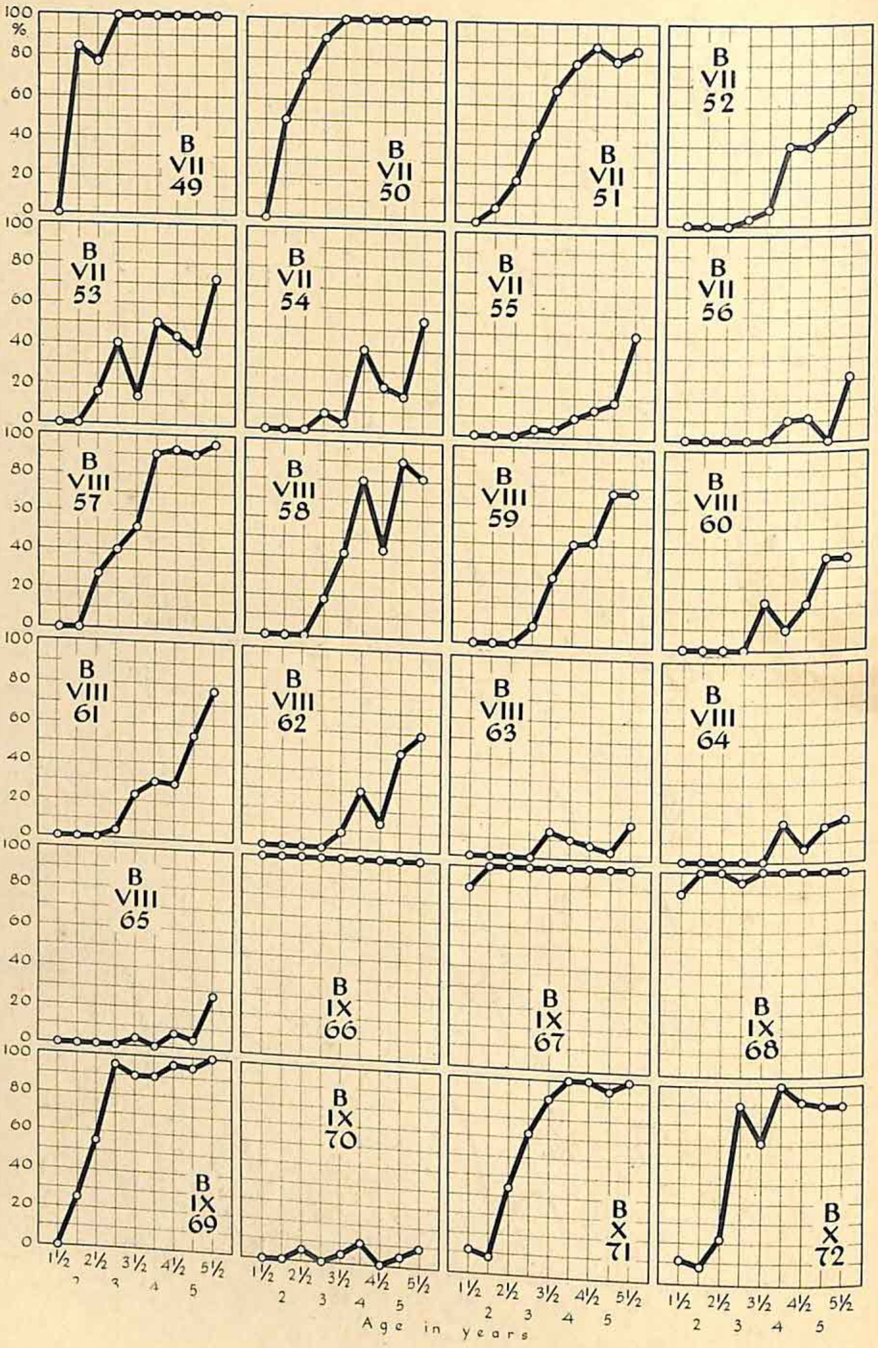
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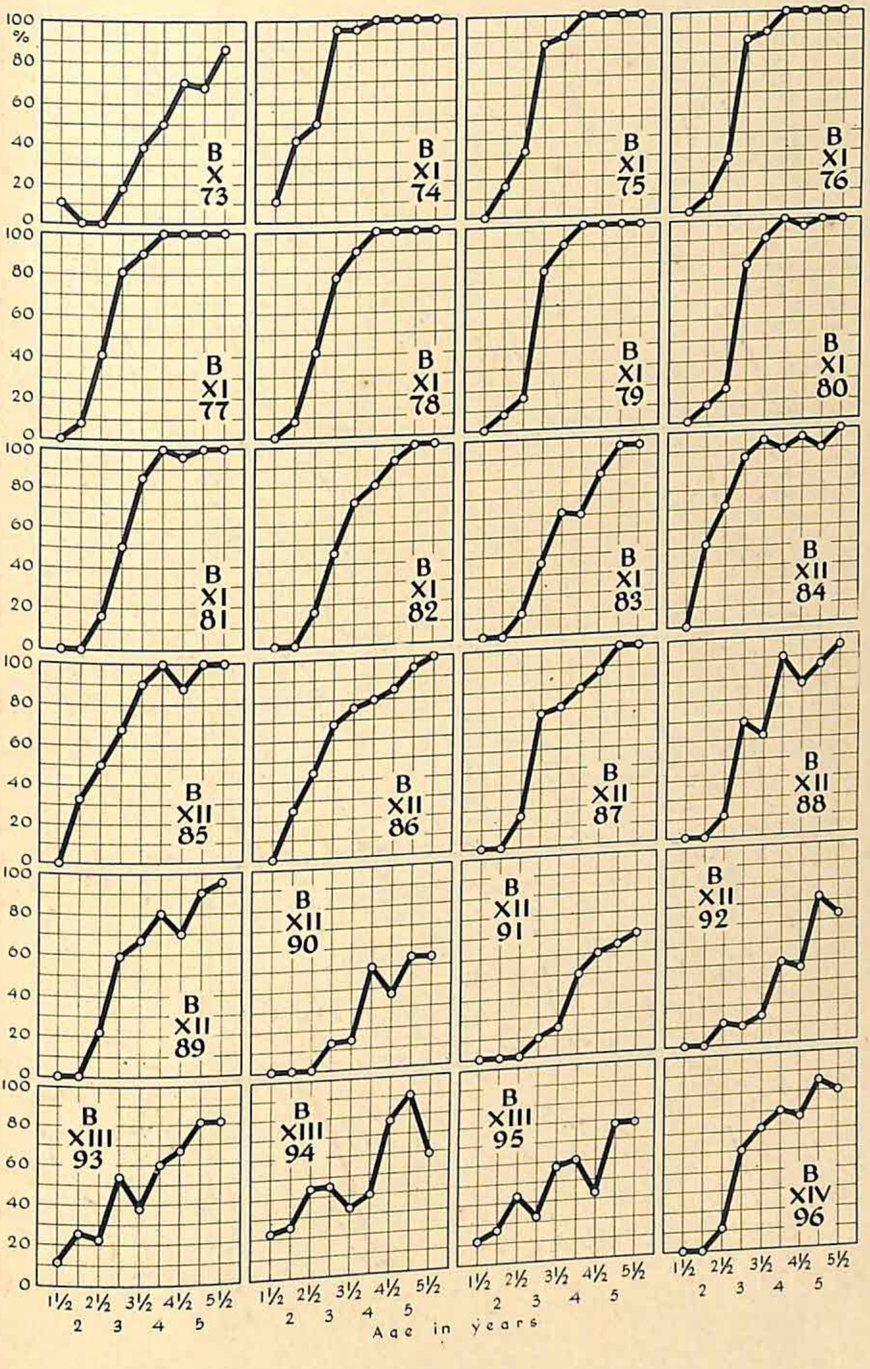
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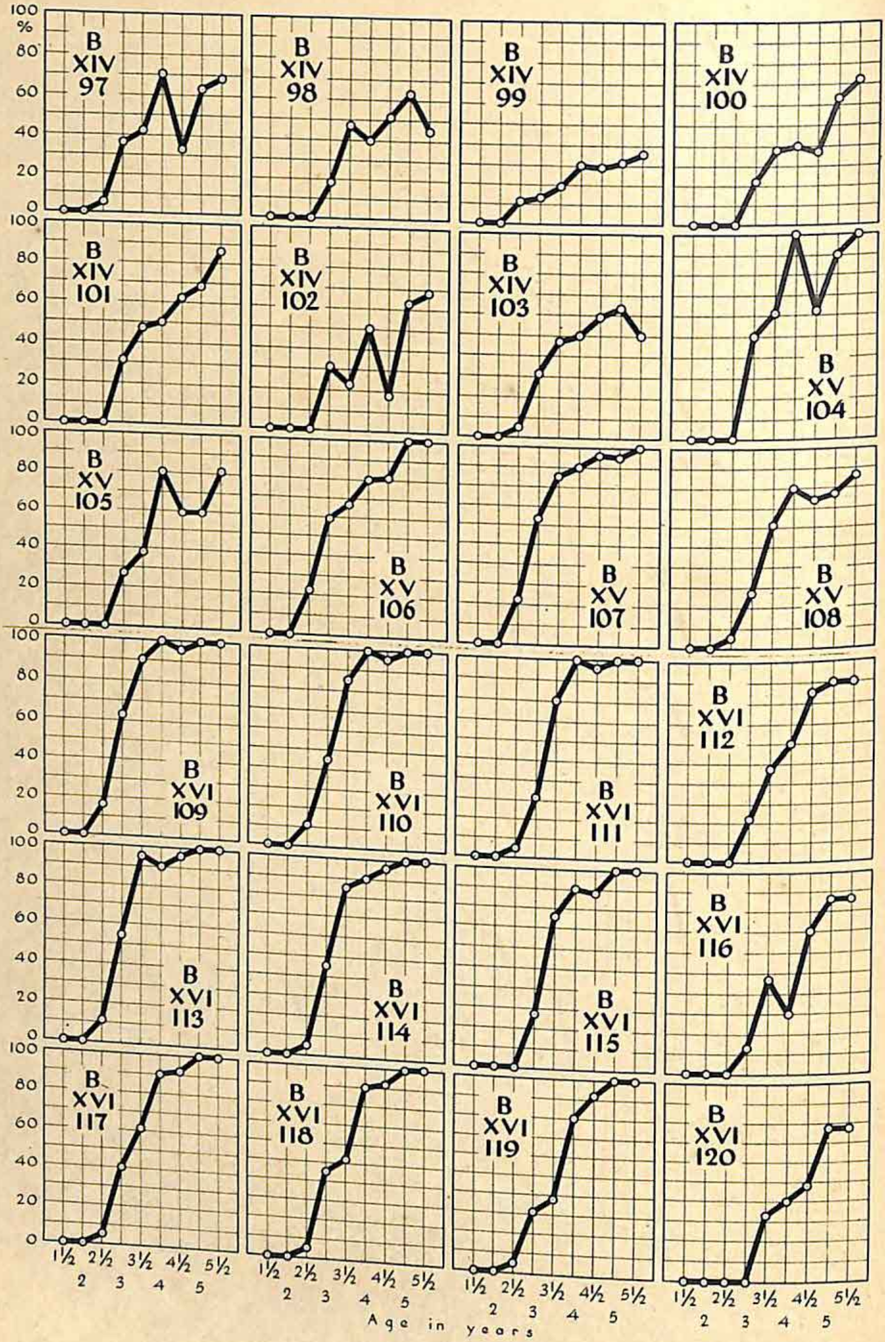
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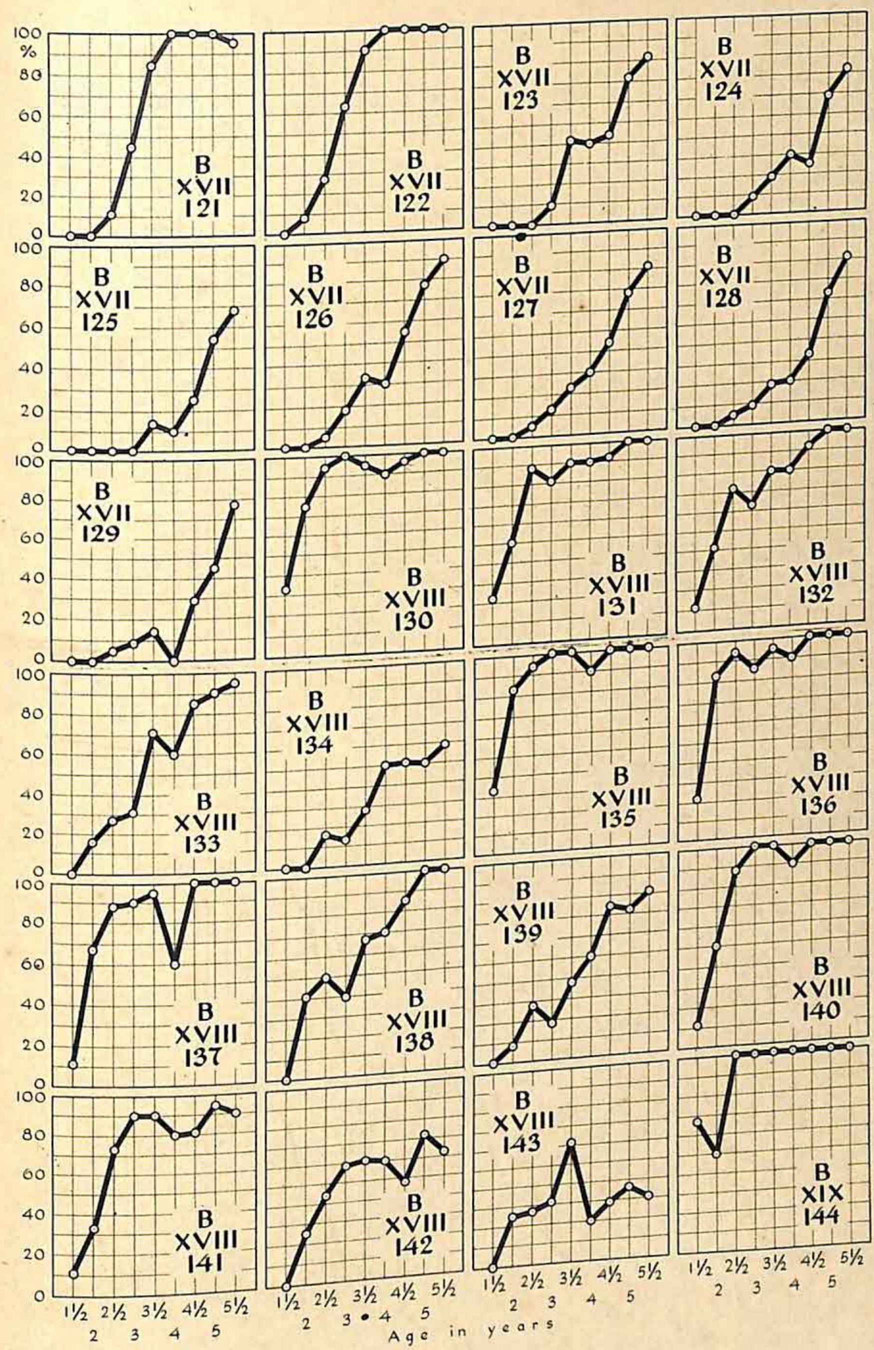
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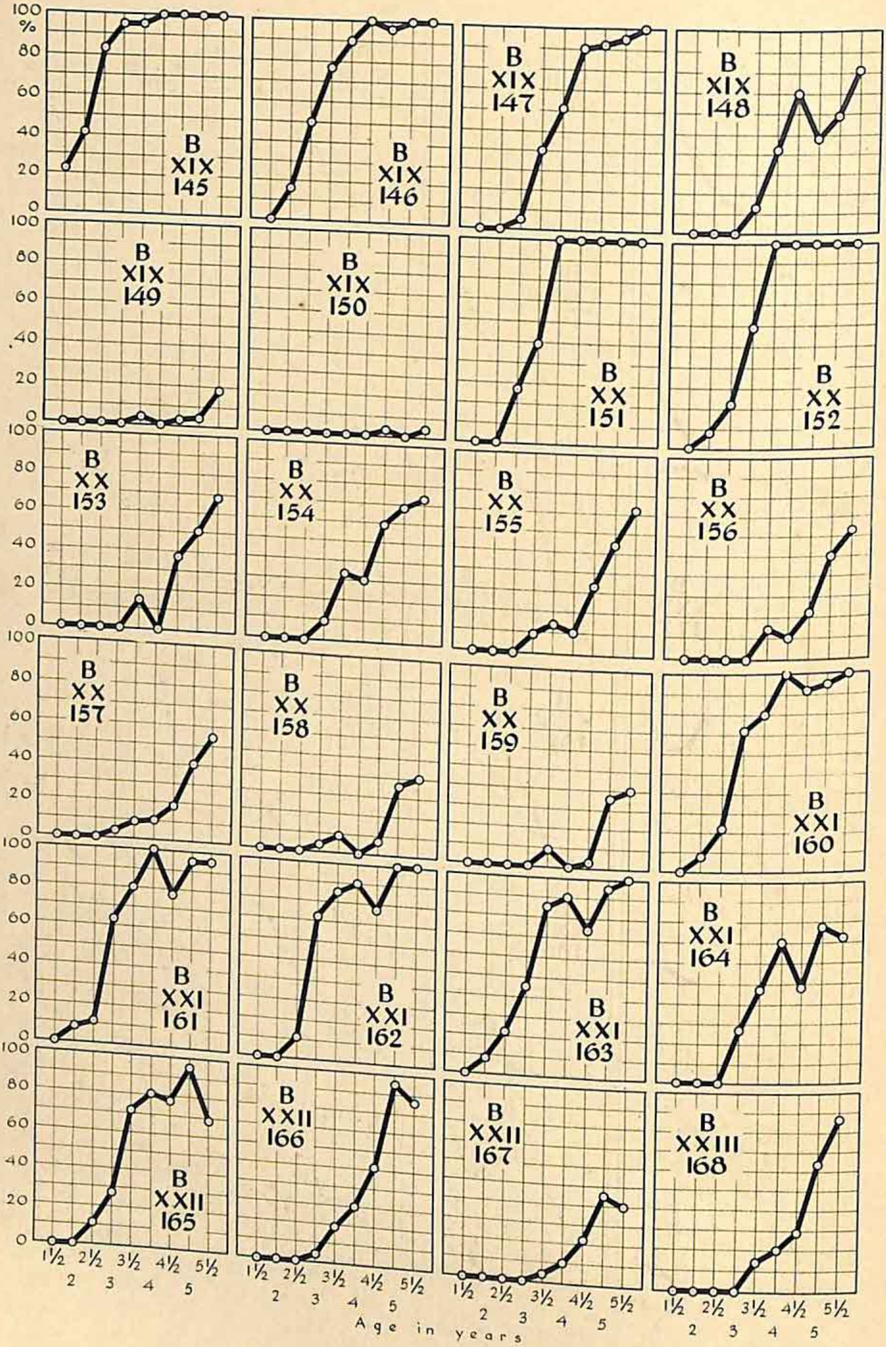
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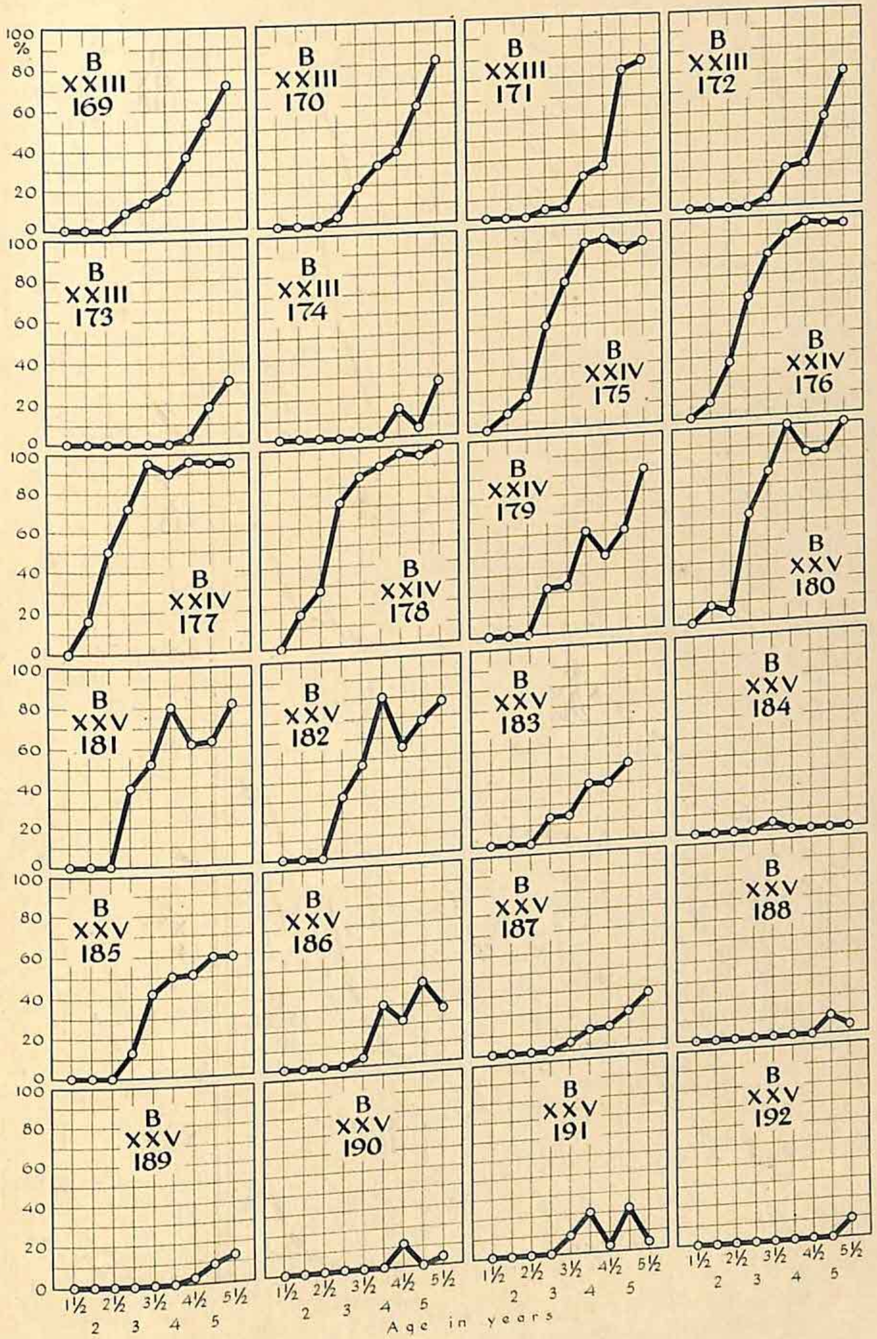
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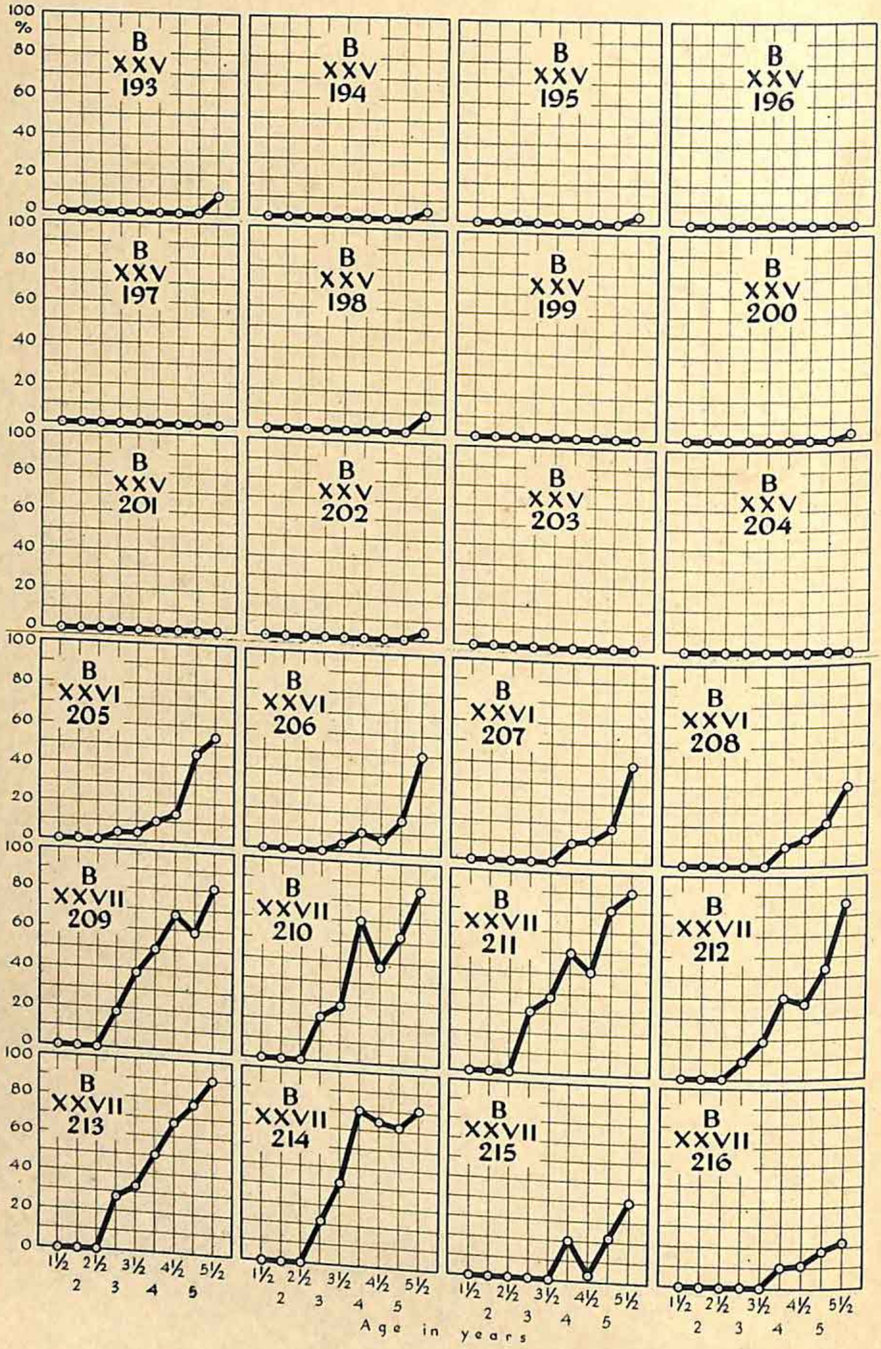

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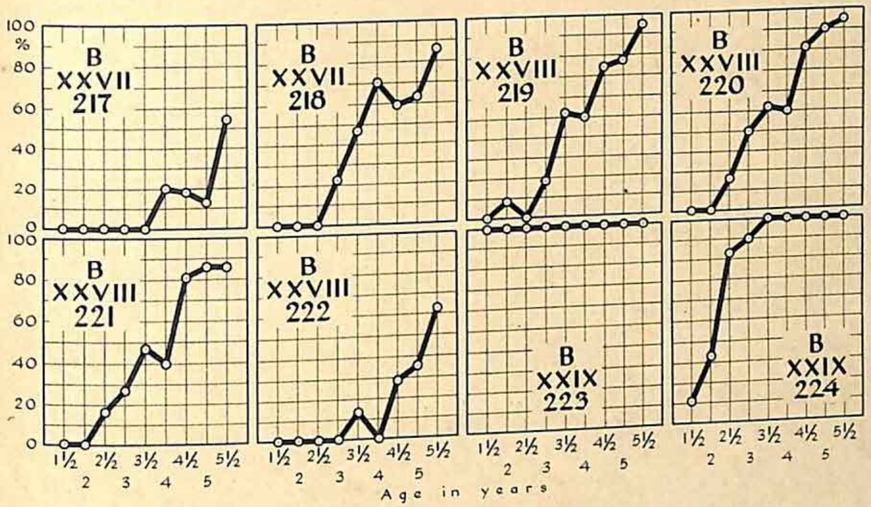
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